SCIENCE ABSTRACTS.

Section A.—PHYSICS.

NOVEMBER 1908.

GENERAL PHYSICS.

1740. *Rebound of a Ball in Relation to Hardness and Elasticity.* **de Fréminville.** (Rev. de Métallurgie, 5. p. 329, June, 1908. Abstracts in Stahl u. Eisen, 28. pp. 1434–1435; Discussion, p. 1435, Sept. 30, 1908. Metallurgie, 5. pp. 574–579, Oct. 8, 1908.)—As the same ball will rebound to an equal height from either unhardened steel, marble, cast-iron, or indiarubber, it is evident that rebound is partly dependent on properties other than hardness. This has been referred to in Abstract No. 1004 (1906). It is difficult to say to what extent hardness affects the height of rebound. For varieties of hardened steel, however, the method gives useful relative values of hardness. In the *discussion*, **E. Maurer** finds that the method gives qualitatively the same results as Martens' sclerometer and Jaggar's microsclerometer. **Breuil** and **Mesnager** state that the agreement with the results of tests by the Brinell method is unsatisfactory. F. R.

1741. *Testing-machines at Glasgow Technical College.* (Engineering, 86. pp. 403–404, Sept. 25, and pp. 472–473, Oct. 9, 1908.)—A 100-ton horizontal testing-machine will test in tension up to a max. stretched length of 15 ft. 6 in.; compression, 15 ft.; transverse tests, 15 ft. span. The hydraulic straining ram is hollow, and works over a stationary ram; the main ram is electroplated with copper. The poise weight is in three portions, which always remain on the beam, and may be used one, two, or three at a time for capacities of 25, 50 and 100 tons respectively, with corresponding degrees of sensitiveness. Damage to the knife-edges at the moment of fracture of the specimen is prevented by receiving the recoil of the crosshead upon collars fixed to the frame of the machine. A machine is described which can test a bar simultaneously in tension (up to 56,000 lbs.) and torsion (up to 12,500 inch-lbs.). The tension is applied by a hydraulic ram which is prevented from turning; and in the length of the shaft which transmits the tension to the weighing apparatus a small oil pressure cylinder without packing is arranged in order that the remainder of the link may not be under torsion. The torsion is applied by hand through a worm-gear. Tensional and torsional stress-strain diagrams are recorded autographically. Illustrations and drawings of each machine are given. The reverse torsion testing-machine is capable of testing a bar in torsion, in either direction alternately, up to a torsional moment of 15,000 inch-lbs. The chucks which grip the specimen, and which are capable of taking bars that have not been machined, when once tightened up have a self-tightening tendency in either direction of torsion, this being due to the action of cam faces on the grips. The shaft, which transmits the torsion from the specimen to the lever system, slides in rollers in a sleeve, in order to obviate any longitudinal stress on the specimen. In either direction of torsion the moment is indicated in the same direction on the steel-yard; there are two intermediate levers between specimen and steel-yard, an upward and a downward movement respectively of the first being transmitted to one or the other end of the second, and hence always as a downward pull to the steel-yard. By an arrangement exactly similar to that in the 100-ton machine, this machine can be used for ranges of 5,000, 10,000, or 15,000 inch-lbs. as desired, with subdivisions of ½, 1 and 5 inch-lbs. respectively. F. R.

1742. *Hardness and Elasticity of Metals.* **A. Kürth.** (Zeitschr. Vereines Deutsch. Ing. 52. pp. 1560–1566, Sept. 26, and pp. 1608–1611, Oct. 8, 1908.)—The results of experiments on copper and nickel from which the law $P = aD^n$ is deduced [see Abstract No. 1368 (1908)] are given in detail. The hardness number is $H = \frac{4}{\pi} a^{\frac{2}{n}} P^{\frac{n-2}{n}}$. For a given metal the value of n depends on the condition of the metal as regards strain, and has its highest value in the annealed material. Comparing hardness measurements with constant diameter and angle of impression, the hardness of a metal is related to its yield-point by a straight-line law over the whole range of hardening by straining in tension. These lines for different values of D intersect approximately at the point corresponding to yield-point equal to breaking load divided by contracted area. It is argued that the slope of the line is proportional to the amount of energy of deformation which is converted into potential energy as cohesion. An increase of strength of a metal is accompanied by an increase of internal energy, whether accomplished by cold work, or, as in the case of steel, by the quenching process. Electrical resistance and magnetic permeability appear to be related to yield-point by a law similar to that followed by hardness, and it is considered probable that each of these properties is independently related to the nature of the cohesion obtaining in the sample. The curves relating η, the ratio of tensile strength to hardness, to the value of the exponent n, coincide for copper, nickel, and iron very poor in carbon, for a given diam. of impression. Hence the conclusion that when materials are cold-worked to corresponding extents, as defined by their having equal values of n, then they have also equal values of η for equal impression angles. F. R.

1743. *New Fatigue Test for Steel.* **T. E. Stanton.** (Iron and Steel Inst., Journ. 76. pp. 54–62; Discussion and Correspondence, pp. 63–70, 1908. Abstracts in Mech. Eng. 21. pp. 652–653, May 22, 1908. Engineering, 85. pp. 696–697, May 22, 1908. Metallurgie, 5. pp. 307–310, June 8, 1908.)—The sample is in the form of a ring and is placed betwen three rollers, one of which drives the others through the specimen, which is thus submitted simultaneously to alternate bending and to abrasion. Pieces of rail steel flow considerably under this test, and generally the fracture travels almost directly across the section of the ring. The numbers of reversals of stress required to fracture the rings are given, with an approximate value of the stress at commencement of test, to which the author does not attach much value. Although generally in the samples studied a high Brinell hardness-number is accompanied by a high endurance in the test, yet in some cases steels with a lower hardness-number and a low tensile strength and ductility, endure better than harder and stronger steels. This is probably on account of the very considerable spreading and hardening of the outer surface of the softer steels under the action of the rollers. Two nickel steels (about 8·8 and 1·5 per cent. Ni respectively) behaved better under the test than carbon steels. The tests were made at a speed of 800 reversals of stress per min., but it is hoped to obtain high rates, up to 4,000 or 5,000 per min. The relative importance of the abrasive action and the stress can be regulated by using rings of different proportions of radial thickness to diameter. F. R.

1744. *Study of Breakages.* **W. Rosenhain.** (Engineering, 86. pp. 840–843 and 844; Discussion, p. 331, Sept. 11, 1908. Paper read before the British Assoc. at Dublin. Mech. Eng. 22. pp. 421–423, Oct. 2, and pp. 442–445, Oct. 9, 1908. Abstract.)—Explanations of some failures are deduced from the results of mechanical tests and microscopic examination. The cracking of the inner tube of a gun is ascribed to excessive contamination with minute slag enclosures, which, having elongated in forging, diminished the circumferential strength to a greater degree than that in a longitudinal direction. A 12-in. shaft which failed in service was found to have an overheated structure in its central parts and a fine-grained layer near the surface, indicating a faulty combination of heat and forging treatment. A locomotive crank-pin had failed by the spreading of cracks which had started through a too severe quenching. F. R.

1745. *Hardness of Constituents of Iron and Steel.* **H. C. Boynton.** (Iron and Steel Inst., Journ. 77. pp. 133–152, 1908.)—A continuation of work referred to in Abstract No. 5 (1907). The hardness of ferrite is about 4 and pearlite 5 on Mohs's scale; sorbite comes between apatite and quartz, troostite a little softer than quartz, and austenite about the same as quartz. The hardness of the harder constituents of iron and steel cannot, however, rationally be compared with the Mohs's minerals by the method used. In drawing a wire of 0·77 per cent. carbon steel through six dies from 0·156 in. to 0·054 in., there was no increase in the hardness of the grains of sorbite, but on further reduction considerable hardening of the sorbite took place. Electrolytic iron, similarly wire-drawn, was not hardened at all. The author failed to recognise the hardened phase in ferrite; and if pure iron is changed allotropically by pressure, it is to be expected that this change would reverse on removal of the pressure, in the absence of carbon. The presence of 0·5 to 1·0 per cent. of W, Cr, or Mn in steel does not affect the hardness of the ferrite; but 0·5 per cent. W increases the hardness of pearlite 8-fold, 1 per cent. Cr increases it 7-fold, and 1·8 per cent. Mn 7·5-fold. F. R.

1746. *Stresses in Wire Ropes due to Bending.* **R. W. Chapman.** (Eng. Rev. 19. pp. 258–269, Oct., 1908. Paper read before the Australasian Inst. of Mining Engineers.)—The author criticises the Reuleaux and Hrabak formulæ for the stresses due to bending in a wire rope. From the change of curvature of a single helix whose axis is bent into a circle it is readily deduced that the max. stress due to bending is $(Ed\cos^2\alpha\cos^2\beta)/D$, where E is Young's modulus for the steel of which the wires are made, d is the diam. of each wire, D that of the rope, α the angular pitch of the wires in the strand, β that of the strands in the rope. In direct tension each helix of wire is not perfectly free to behave as a spiral spring in tension; hence, although the elongation of the rope as a whole is greater than it would be if it consisted of a bundle of parallel wires, yet it is not so great as for a number of free helices. Doubtless to some degree the same action occurs in a rope bent over a pulley. Tables give the tensions required to produce the same stress as given by the bending, for various ropes and diameters of drum. The results of experiments are given in which pieces of rope were bent by a known force or to a known radius. The formula is found to be in good agreement with the results. By bending in the opposite direction the work absorbed in overcoming internal friction is estimated. This amounts approximately to $Ml/2R$, where M is the bending moment required to bend a length l of the rope to radius R. F. R.

1747. *Compression Members of Bridges.* **H. E. Horton.** (West. Soc. Engin., Journ. 13. pp. 319–329; Discussion, pp. 329–352, June, 1908.)—A general discussion. The author gives the following as the form of the Gordon formula which he has adopted. The load divided by area of section of metal of the member is not to exceed ¾ of the limiting stress, $f = 20{,}000$ lbs. per sq. in. (say), adopted for the material, and $= 1{\cdot}5f/(1 + L^2/5000R^2)$. A specification for such members is drawn up in detail, except as regards quality of metal. The rule proposed for cover and batten plates, and latticing, in planes parallel to the length of member, is that these should be capable of sustaining the member, regarded as of 2·5 times its actual weight, disposed as a horizontal girder supported at the two ends only. Lattice bars should be of the same section throughout a member. In the *discussion*, **A. Reichmann** obtains a formula for the stress, S, in latticing: $S = (140Ar \sec. \alpha)/e$, where A is the total area of section of chord, r is the radius of gyration of section about an axis in its plane, perpendicular to the latticing, e the distance from this axis to edge of section, and α the inclination of latticing to length of chord. On account of the uncertainties of the secondary stress introduced near the points of connection, it is advisable to make S low, say from 6,000 to 8,000 lbs. per sq. in. It is suggested that there would be an advantage in connecting the horizontal leg of flange angles to the cover-plates by a single rather than a double line of rivets, as the efficiency of rivets in this position increases with their distance from the web. **O. H. Basquin** points out that the max. value of the shear at the end of a column can be proved equal to $(Pe/r)\surd(p/E) \tan [l\surd(P/E)]/2r$, where P is load, p is P divided by sectional area of column, l the length, r the least radius of gyration of section, E Young's modulus, and e the eccentricity of the load, whose value may be chosen from a knowledge of the conditions of loading, the workmanship to be expected, or from an analysis of tests by Moncrieff (Amer. Soc. Civ. Engin., Trans., 1901), who showed that the values of ec/r^2 in practically all published tests lie between 0·15 and 0·6. Here c is distance from the axis of chord to the most stressed layer. **W. C. Armstrong** compares the values given by existing lattice formulæ, and arrives by analysis at the following: $S = 8fI/ndl \sin \alpha$, where d is depth of channel or leaf composing the column, n is the number of bars per lattice panel, I the moment of inertia of the section, and the other symbols are as above. This gives values in good agreement with usual practice. **A. Allen's** view is that lattice bars are dead members, and should be avoided wherever possible; when it is necessary to use them they should be liberally proportioned. The rule proposed is that one half of the concentrated load be regarded as shear, and the lattice bars and rivets be proportioned to carry it—the bars the diagonal component, and the rivets the transverse component. F. R.

1748. *Economy in Ferro-Concrete Design.* **O. Faber.** (Engineering, 86. pp. 163–165, Aug. 7, and pp. 197–198, Aug. 14, 1908.)—The usual theory for use in design of ferro-concrete beams, flooring and columns is given, with special reference to economy in designing. Particular reference is made to the cost of "shuttering," *i.e.*, the forms in which the concrete is set, which often amounts to such a considerable factor as to affect the choice between a few deep or many shallow floor beams. **H. B. Gates.** (Ibid. p. 288, Aug. 21, 1908.)—Gates criticises Faber's statement that although the most economical percentage of steel in a beam is usually stated to be that with which the highest permissible stresses are reached in both steel and concrete, yet it is often economical to insert a higher percentage of steel, and keep the stress at a lower value. Faber maintains this view in a brief argument. F. R.

1749. *Tests of Cast Iron and Reinforced Concrete Culvert Pipes.* **A. N. Talbot.** (West. Soc. Engin., Journ. 13. pp. 376–418; Discussion, pp. 418–433, June, 1908.)—Gives the results of a number of tests on complete lengths of about 8 ft., and portions about 2 ft. long, of pipes 36 and 48 in. internal diam. Distributed external loads were applied by bedding the pipes in wet sand, and loading by jacks. Concentrated loads were applied by means of a 300-ton testing machine. Load-deflection diagrams are given, the deflections measured being the change of internal diam. A "critical load" is recognised at which the load-deflection curve of reinforced concrete pipes definitely changes its direction. The deflections of cast-iron rings under concentrated load were nearly proportional to the loads applied. The modulus of elasticity deduced from the deflections was 10,200,000 lbs. per sq. in., and the ultimate stress 27,000 lbs. per sq. in., which is 25 per cent. less than the value given by rectangular bars cut from rings. Bedding in sand as above described gave a somewhat uncertain distribuion of load, but reasons are given for expecting the intensity of the horizontal pressure to be equal to about one-fourth of the vertical. Deflection at the spigot end of pipes generally increased uniformly with load, but at the bell end the deflections lagged and gave a curved line. In the cast-iron pipes generally, fracture occurred first at top or bottom, *i.e.*, nearest to the points of application of load, and in the sand-bedded pipes such cracking commenced at from 75 to 100 per cent. of the ultimate load. Plain concrete rings failed under very low loads, and with concentrated loads the deflection was very slight. Reinforced concrete rings under concentrated load withstood loads of from 1,000 to 2,150 lbs. per lineal ft. Reinforced concrete rings showed very fine cracks at relatively low loads, *e.g.*, 5,000 lbs. per ft. run, but this did not materially affect the strength, which in several instances was equal to that calculated for the proportion of steel used. Beyond the "critical" load the load increases, but the reinforcement becomes more and more exposed, and it is only due to the pressure of the sand at the sides that the pipe is prevented from failing completely. It is considered that the results agree reasonably well with theoretical formulæ. The max. bending moment at the crown of a pipe may be taken as $Wd/16$ when the bedding is properly carried out, but otherwise this should be suitably increased ($W =$ unit pressure, and $d =$ external diam. of pipe). The critical load of reinforced concrete pipe in which the section of steel does not exceed 0·75 per cent. of the section of concrete may be calculated by the ordinary reinforced concrete beam formulæ. The resistance to diagonal tension and to stripping of the concrete may be increased by placing the reinforcement nearer the surface towards the crown and bottom of the pipe, and possibly also by the use of stirrups at these points. In the *discussion* several speakers dwelt upon the need of care in bedding the pipes, the dimensions, and the relative general dimensions of iron and concrete pipes. **A. O. Cunningham** gives designs of short lengths of reinforced concrete pipes. **C. S. Churchill** gives specifications for cast-iron pipes, and **A. S. Baldwin** gives the specifications for laying cast-iron pipes in use on the Illinois Central Railway. F. R.

1750. *Breaking Stress of Glass under High Pressures at Ordinary and Low Temperatures. Isotherms of Diatomic Gases and their Binary Mixtures.* VIII. **H. Kamerlingh Onnes** and **C. Braak.** (Konink. Akad. Wetensch. Amsterdam, Proc. 11. pp. 80–87, Sept. 8, 1908.)—As it is desirable that the reservoirs of the manometer tubes of the open manometer and the divided stems of the piezometer tubes should be made of glass, the authors have determined the max. internal pressure and the breaking stress of (1) thick-walled glass tubes with large bore; (2) thick-walled capillaries; (3) thin-walled tubes with wide bore. The max. stress of glass threads was also measured at the temperatures of liquid air and of liquid hydrogen; the max. stress increases as the temperature falls. The results are given in detail. [See Abstract No. 1275 (1908).] T. H. P.

1751. *Rolling and Pitching of Ships.* **O. Hecker.** (Zeitschr. Instrumentenk. 28. pp. 265–268, Sept., 1908.)—Describes the use of an apparatus for registering the amount of pitching and rolling of ships. Use is made of special pendulums, the suitability of which for the purpose is discussed at some length. The pendulums consist of thick metal discs suspended from knife-edges at a point on the circumference. To the top of these discs are attached long light arms carrying pencils which register the motion of the pendulums on the same sheet of paper, which is carried on slowly rotating cylinders. The pendulums are so mounted that one oscillates in the plane through the ship's keel, and the other in a plane perpendicular to the first and registers the rolling motion. The pendulums used by the author in his experiments on several large ships were of the following dimensions: diam., 4 cm.; thickness, 1·6 cm.; the registering arm was made from thin sheet Al and was 11·4 cm. long. A diagram is given of the curves obtained with the four ships experimented with. A. W.

1752. *Soaring.* **E. Esclangon.** (Comptes Rendus, 147. pp. 496–498, Sept. 14, 1908.)—Referring to the speculations of M. Deprez [Abstract No. 1283 (1908)], the author points out that an ascending current of air is not absolutely necessary for continual soaring. As Langley remarked years ago, it is only necessary that the bird or æroplane should have some power of utilising any difference with respect to the mean horizontal motion of the air, whether in direction or velocity. These differences require to be converted into differences of height or of speed, which latter are mutually convertible. Most winds, especially high ones, have a certain structure which gives to them local differences of direction and speed. A mechanical method of utilising these differences is required to render soaring without motive power possible. E. E. F.

1753. *Contour Lines of Oscillating Surfaces.* **T. Terada.** (Mathematico-Physical Soc., Tôkyô, Proc. 4. 18. pp. 251–255, Feb., 1908.)—A photographic method of recording liquid oscillations. Above the vessel containing the liquid a large glass plate is mounted at an angle of 45° to the vertical. In front of the glass plate a zinc sheet perforated with regular rows of small holes is fixed vertically, the holes being strongly illuminated. Then the image of these holes formed by the liquid surface can be seen from directly above the inclined glass plate. A photographic camera is set above the basin and focussed on the image. When the tank is slightly oscillated the images of the luminous points oscillate about their positions of rest and form on the photographic plate a beautiful pattern of luminous streaks. The author used circular tanks, and subsequently models of certain lakes. In one case circular or elliptic paths were drawn. This is explained by supposing that the liquid is capable of two normal modes of oscillation with a common period. The method may also be applied to elastic membranes. E. E. F.

1754. *Viscosity of Ice.* **R. M. Deeley.** (Roy. Soc., Proc. Ser. A. 81. pp. 250–259, Sept. 11, 1908.)—Taking the velocities of certain glaciers as determined by Tyndall, the author estimates their thicknesses and calculates the viscosity of glacier ice. His results are as follows :—

Glacier.	Thickness in Metres.	Velocity in Inches per Day.		Slope, One in	Pressure in Dynes per cm.².	Viscosity in c.g.s. Units.
		Including Slip.	Without Slip.			
Mer de Glace—						
At Trélaporte	210	20	17	18·5	66·82	29·48 × 10^{12}
At les Touts	210	28	20·5	12	75·17	27·51 ,,
Above Montanvert	210	26	22·25	11	82·00	27·64 ,,
At Montanvert......	210	34	29	10	90·20	23·33 ,,
Below Montanvert	210	33	28	10	90·20	24·16 ,,
Morteratsch, Pontresina—						
High up...............	400	14	12	7	128·90	292·2 ,,
Middle	290	11	9	10	90·20	148·4 ,,
Above end............	190	7	6	10	90·20	92·81 ,,
Lower Grindelwald	100	22	18·75	25	36·09	8·274 ,,
Great Aletsch	450	—	10	15·4	58·68	126·2 ,,

The author concludes that 125 × 10^{12} is as near an estimate as can yet be made of the average effective viscosity of a Swiss glacier. He also deduces values of the viscosity of ice in the form of bars from the late J. C. McConnel's experiments; these values show a fairly continuous increase of viscosity with falling temperature to —15° C. E. H. B.

1755. *Vortices in Oscillating Liquid.* **Rayleigh.** (Roy. Soc., Proc. Ser. A. 81. pp. 259–271, Sept. 11, 1908.)—In a paper "On the Circulation of Air observed in Kundt's Tubes, and on some Allied Acoustical Problems" (Phil. Trans., 1883, Scien. Papers, vol. ii. p. 239), the author applied the equations of viscous incompressible fluid to show that the effect of the bottom of the containing vessel was to generate permanent vortices in the vibrating fluid. It was remarkable that the intensity of the vortical motion, when fully established, proved to be independent of the magnitude of the viscosity, so that the effects could not be eliminated by merely supposing the viscosity to become extremely small. The expressions then found showed that the vortical motion is downwards over the places where the horizontal velocity of the primary motion near the bottom has its greatest alternating values. In the case of water contained in a tank and vibrating in its simplest mode, the theoretical motion is downwards in the middle and upwards at the ends. To guard against misinterpretation the author adds that, quite close to the bottom, the calculated motion is of a quite different character. In a recent paper Mrs. H. Ayrton examined with much experimental skill the vortices arising when water oscillates in a narrow tank [Abstract No. 889 (1908)], and obtained results which differ somewhat widely from those indicated in the theoretical work just referred to. Near the bottom, and especially when the depth is small, there are indeed vortices of the character theoretically predicted, but in general the most conspicuous feature consists of vortices revolving in the opposite direction, the water rising in the middle of the tank and falling at the ends. The question then arose as to whether the free surface itself might not originate vortices in somewhat the same way as the bottom does, and more potently on account of the greater velocities of the primary motion there prevailing. The present paper attacks this question mathematically, the investigation being limited to the case of deep water, and is even then somewhat complicated. It shows that a free surface does *not* generate vortices of this kind, at least if we suppose the viscosity small and include only the square of the motion. The paper leaves the subject undecided, the suggestion being, however, made that the retention of terms of higher order than the *square* of the motion may perhaps be needed to explain the vortices observed by Mrs. Ayrton. E. H. B.

1756. *Diurnal Temperature Curve in the Free Atmosphere.* **W. Wundt.** (Meteorolog. Zeitschr. 25. pp. 337–341, Aug., 1908.)—The author examines the records collected at Hald, in Jutland, at the Franco-Scandinavian station under Teisserenc de Bort, in 1902–1903, by means of balloons and also of kites. The number of ascents varied between 9 in July and 47 in Nov. and March; half-hourly records were available, but June observations were not taken at all, and no night observations during Jan. Assuming a temperature gradient of 0·5° C. per 100 m., the author reduces all his data to the average height obtained, 1,200 m.; he is aware that his method is open to objections. He finds a chief temperature maximum between noon and 1 p.m.; a secondary evening maximum becomes more pronounced as the altitude increases; this evening maximum in the higher strata is a convection maximum, the other a radiation maximum. Secondary night maxima occur at midnight and at 5 a.m.; in general the temperature rises steadily from 2 a.m. to noon. Reference is made to the observations of secondary night maxima by Kämitz, Hellmann, Trabert, Angot, de Martonne, Bigelow and others. H. B.

1757. *Diurnal Atmospheric Variation in the Tropics, and Surveying with the Aneroid.* **T. G. Gribble.** (Inst. Civ. Engin., Proc. 171. pp. 320–329, 1907–1908.)—The regularity of the changes in atmospheric pressure in the Tropics makes it possible to use the aneroid, without separate recording barometer, as an instrument of precision. The mean height of the barometer varies in England about 15 times as much as in Java; but the 12-hour wave has in Java at sea-level an average range of 1·84 mm. at night and of 2·87 mm. during the day—about 4½ times as much as in England. The range of the day-wave at sea-level is equivalent, in Java, to over 100 ft. in altitude; during some parts of the day the change in an hour is equivalent to a level-difference of 5 ft., so that the time of the day may literally be told by the height of the barometer. The author has carried out some surveys for the utilisation of water-power in Java. The aneroid survey requires five operations: (A) The determination of the mean barometer and of the characteristics of the diurnal variation at sea-level; (B) determination of the altitude of the principal station at the highest point of the survey; (C) determination of the difference in elevation between the upper and lower limits of the survey; (D) determination of the elevation of intermediate fiducial points; (E) determination of the actual longitudinal profile of the line of survey. The aneroid work was checked by the Abney reflecting hand-level; both agreed well. The whole survey of the profile of the Toentang Valley, 250 to 400 m. above sea-level, including alignment by means of the prismatic compass, side-slopes, sketches and photographs, was completed in a day. H. B.

1758. *Accumulation of Helium in Geological Time.* **R. J. Strutt.** (Roy. Soc., Proc. Ser. A. 81. pp. 272–277, Sept. 11, 1908.)—In a former paper the author gave an account of experiments on the presence of helium in a variety of the common minerals of the earth's crust. The conclusion reached was that the quantity of helium is, in general, determined by the traces of radio-active elements present. The minerals investigated were mostly of palæozoic age, and little attention was paid to the effect of geological age on helium content [see Abstract No. 1489 (1908)]. If, however, the accepted theory of the progressive accumulation of helium in minerals by radio-active change is correct, it is evident that geological age must be all-important. In the present paper the subject is accordingly considered from this point of view. The helium was extracted by solution of the powdered substances in HCl. The chief conclusions reached are shown in the table:—

Material.	Geological Horizon.	Helium in mm.^{3} per 100 gm.	Uranium Oxide (U_3O_8) in gm. per 100 gm.	Provisional Minimum Ages of Materials in Millions of Years.
Phosphatic Nodules	Upper Greensand...	8·08	0·0108	
Phosphatic Nodules	Lower Greensand...	2·10	0·00588	8·95
Hæmatite	Above Carboniferous Limestone	16·5	0·00128	141

The times in the last column are obtained provisionally by adoption of Rutherford's latest estimate, viz., that 816 mm.^{3} of helium are produced by 1 gm. of radium per annum. Taking the ratio of radium to uranium in minerals as $8·4 \times 10^{-7}$, the author then obtains $9·18 \times 10^{-8}$ cm.^{3} for the annual helium production per gm. of uranium oxide in a mineral. The values of the times are thus provisional only and subject to revision when the rate of growth of helium has been directly determined. E. H. B.

1759. *Heavy Constituents of the Atmosphere.* **R. B. Moore.** (Roy. Soc., Proc. Ser. A. 81. pp. 195–209, Aug. 27, 1908.)—An exhaustive examination of the highest boiling constituents of the atmosphere. The residues from 19 tons and from 100 tons of air were freed from oxygen and nitrogen and were fractionated. Every care was taken to guard against loss of an unknown gas by solution in the water over which the mixture stood or by occlusion in the magnesium and lime tubes. No traces of any new constituent were found, which means that if such a new constituent exists it must be, in all probability, in less quantities than 1 in 2,560,000,000 parts of air. E. C. C. B.

1760. *Solid-earth Tides.* **R. L. Faris.** (Monthly Weather Rev. 36. pp. 166–169, June, 1908. Paper read before the Philosoph. Soc. Washington, May 23, 1908.)—The author discusses the results of a series of horizontal pendulum experiments made by O. Hecker, at Potsdam, for the purpose of studying the disturbances of the plumb-line under the attractive influence of the sun and moon. The work lasted during the twenty-eight months from Dec., 1902, to May, 1905, and a modified form of v. Rebeur's pendulum was employed, installed in a specially designed room, 25 m. below the ground-level, connected with the well of the Astrophysical Observatory at Potsdam. The movements of the pendulum were recorded photographically, with a time scale of 12·5 mm. per hour. It was found that the observed deflection of the plumb-line, caused by the moon's attraction, was about two-thirds of what it would be for an absolutely rigid earth. Although the sun's effect is only about half that of the moon, these pendulum observations clearly show the tide-producing influence of both the sun and moon upon the solid earth.
C. P. B.

1761. *Disturbances of the Solar Atmosphere.* **H. Deslandres.** (Comptes Rendus, 147. pp. 467–474, Sept. 7, 1908.)—The spectroheliograms recently obtained so successfully with the red hydrogen line Hα probably include all that radiation, say as much as 0·9 tenth-metre; the recent K_3 photographs at Meudon are arranged to represent a much smaller range of wave-length, about 0·04 tenth-metre. As the hydrogen and K_3 radiation both represent the higher parts of the solar atmosphere, it is important to compare the results given by these different methods. A discussion of the more recent photographs in conjunction with the old ones enables the author to trace the history of several features which have proved difficult. The motions and forms of the long dark filaments and their relation to the faculæ suggests the presence of two kinds of solar cyclonic movement, with axes vertical and horizontal respectively, and if this be true it may prove possible to explain many solar phenomena by analogy with our own atmospheric disturbances.
C. P. B.

1762. *Greenhouse Theory of Planetary Temperatures.* **F. W. Very.** (Phil. Mag. 16. pp. 462–480, Sept., 1908.)—Various attempts have been made to apply the phenomenon of heat conservation by enclosed glass structures to the theory of planetary atmospheric temperatures. In the ideal case, where all the solar radiation would be arrested and transformed into radiation of different wave-length, there would still be the time-factor to consider; where a layer of conducting material of indefinite thickness is to be heated, a day is too short a time to reach thermal equilibrium, but for a small thickness a second might be sufficient. The author considers the conserving action of an extended series of arresting screens, each of very small absorption, and moreover suggests that the true constitution of matter may really resemble such a collection of screens: the particles are really discontinuous, and the interspaces may act as a series of chambers through which thermal energy may be transferred from molecule to molecule by a process which involves a time-factor and discontinuous mechanism. Experimental readings under multiple glass screens showed that a temperature higher than that of boiling water could easily be attained, with the sun's altitude about 50° and the solar radiation about 1·80 small calories per cm.^{2} per min. From this it is computed that the sun can give at the earth's distance a temperature of 468° abs., which agrees with the value previously determined by the author for the moon's temperature at lunar midday (454° abs.). Consideration is then given as to how much of the solar radiation is arrested by the upper water-vapour layers of the atmosphere; this must be considerable, and may account for the departure from the adiabatic rate found by recent observations by sounding balloons, indicating the existence of a high-level isothermal stratum. Following Lowell, the author then discusses the influence of albedo on a planet's temperature. As about a third part of the sun's radiant energy is in the visible spectrum where selective scattering is most effective, the earth, with its greater albedo, will receive a smaller proportion of heat at its surface than the planet Mars. The effects due to diffraction and scattering reflection from dust particles are also considered. It is suggested that the major planets have atmospheres containing unknown and highly absorbent gases which produce bands in the visible spectrum, increasing in strength with the distances of the planets from the sun. These bands invade the red end of the spectrum, but diminish in width and blackness towards the shorter waves, and die out near the middle of the visible spectrum. This suggests that there may be present in the atmospheres of these planets substances having very numerous and intense absorption bands in the infra-red; if these bands are so strong that they give metallic reflection for surface radiation, even the small amount of energy in the solar radiation on Neptune could be so largely stored up that a high surface temperature might be maintained.

C. P. B.

1763. *Spectra of the Larger Planets Photographed in* **1907** *at Flagstaff Observatory.* **P. Lowell.** (Comptes Rendus, 147. pp. 516–521, Sept. 21, 1908.)—In 1907, by means of special plates bathed in a mixture of pinacyanol, pinaverdol, and dicyanine, V. M. Slipher obtained at Flagstaff spectra of the moon, Mars, Jupiter, Saturn, Uranus, and Neptune which extended unexpectedly far into the infra-red, showing the important region from C to beyond A. The results for Mars have already been published [see Abstract No. 1619 (1907)]. It may be remembered that the *a* band was found to be decidedly stronger than on the moon. In the present paper the spectra of the four outer planets are compared with that of the moon, and the lines identified so far as possible. A more detailed account by Slipher will shortly be published. The quality of the plates may be judged from the fact that in Neptune 180 lines were counted between λ460 and the solar line A. They are not, however, all contained in the present list, which only gives about a dozen lines in Jupiter and in Saturn, and about three times as many in Uranus and in Neptune, all lying between 739 and 458 $\mu\mu$. In the case of Jupiter only such lines are given as differ from lunar lines taken under the same conditions, and thus indicate differences of composition or intensity between Jupiter's atmosphere and ours. The most striking feature in the general results to which the author calls attention is the progressive accentuation of the bands, both in tone and variety, with increasing distance from the sun. Unfortunately it has not been found possible to print reproductions, the details being too delicate [see, however, reproduction in Nature, 79. p. 42, Nov. 12, 1908]. In particular, the two bands λ618 and λ548, which are absent in the moon, appear in Jupiter, and become by degrees darker and broader in Saturn, Uranus, and Neptune respectively. Two other lines, λ672 and λ578, appear in Saturn, and become stronger in Uranus and in Neptune. Other lines, more numerous, commence in Uranus and are darker in Neptune. The author remarks that the water-vapour lines between B and D appear to be much exaggerated in intensity in Rowland's scale, as compared with the great bands on the less refrangible side of B, probably on account of the greater visibility of the former. The lines between B and D are missing on the author's plates of the moon, Jupiter, and Saturn, although the bands between B and A are strongly shown. Taking into account the dryness of the air at Flagstaff, which renders other details relatively more distinct, he infers that the absence of the lines in question shows that they are really very feeble in the planetary spectra, and if seen by former observers were due only to the humidity of our own atmosphere. From his identification of the bands between B and A, the author deduces the presence of water vapour in Jupiter's atmosphere, and to a still greater extent in Saturn's. The other bands of these planets have not yet been identified. In the spectrum of Uranus F and C are both enhanced, indicating the presence of free hydrogen in the atmosphere of Uranus. They are still more enhanced in Neptune. The appearance of D_3 and of the line λ668 seems to point to the presence of helium in the atmosphere of these two planets. Water vapour, judging from the aspect of the spectra between B and A, appears also to be present. Thus the photographs indicate that the lighter gases occur in the planetary atmospheres in greater abundance as their distance from the sun increases—a result which raises interesting questions of cosmogony. A. E.

1764. *Impossibility of Demonstrating the Existence of an Appreciable Dispersion of Light in Interstellar Space by the Nordmann-Tikhoff Method.* **P. Lebedew.** (Comptes Rendus, 147. pp. 515–516, Sept. 21, 1908.) —According to Tikhoff [Abstract No. 1898 (1908)], the distance of RT Persei (10th mag.) is 740 light-years, and the interval between the minima for wave-lengths 0·56 and 0·48 μ in 4 min. Nordmann [see Abstract No. 590 (1908)] finds that for β Persei, distance 60 light-years, the interval between the minima for 0·68 and 0·48 μ is 16 min., and for 0·51 and 0·48 μ is 9 min., giving, by interpolation, for 0·56 and 0·48 μ the interval 11 minutes. The ratio of the values found by Nordmann and Tikhoff for the dispersion is 11/60 : 4/740, or more than 80 : 1. "It is evident that a method of measurement which gives such different values for the same physical constant must be false in principle." The interval between the minima can be explained without difficulty by seeking the causes in the physical properties of variable stars, and the observations of β and RT Persei afford a striking proof that these properties have a much greater separating effect than the suspected dispersion. Since the physical properties differ for each individual star, it appears to the author impossible to demonstrate an appreciable dispersion of light in interstellar space by the Nordmann-Tikhoff method. **C. Nordmann.** (Ibid. 147. p. 620, Oct. 12, 1908.) A. E.

REFERENCES.

1765. *Use of Extensometer in Commercial Work.* **T. D. Lynch.** (Eng. Record, 58. pp. 303–305, Sept. 12, 1908. Paper read before the Amer. Soc. for Testing Materials.)—Stress-strain diagrams taken with a Ewing extensometer are given for a number of steels, and also showing the curves obtained after loading and repeated loading beyond the elastic limit. F. R.

1766. *Theory of the Leaking Microbarograph.* **Chrystal.** (Roy. Soc. Edinburgh, Proc. 28. pp. 437–460, 1908.)—Includes an account of observations made with a triad of Dines-Shaw instruments.

1767. *New Sounding Machine for use on Lakes and Rivers without a Boat.* **E. J. Garwood.** (Roy. Soc., Proc. Ser. A. 81. pp. 243–249, Sept. 11, 1908.)

1768. *Results of Further Model Screw Propeller Experiments.* **R. E. Froude.** (Inst. Naval Architects, Trans. 50. pp. 185–197; Discussion, pp. 197–204, 1908.)

1769. *An Analysis of the Resistance of Ships.* **W. Hovgaard.** (Inst. Naval Architects, Trans. 50. pp. 205–222; Correspondence, pp. 223–224, 1908.)

1770. *Model Propeller Experiments.* (Engineer, 105. pp. 353–354, April 3, 1908.) —An account of Flamm's experiments, carried out in Berlin, on towed propellers without hulls.

1771. *Report upon the Dry Period and Rain-making Experiments at Oamaru, New Zealand.* **D. C. Bates.** (Monthly Weather Rev. 36. pp. 208–213, July, 1908.) —An account of some experiments which gave results, on the whole, of a negative character.

1772. *Eastward Circulation of Atmosphere.* **J. M. Schaeberle.** (Science, 28. pp. 415–416, Sept. 25, 1908.)—An endeavour to explain the eastward circulation of the atmosphere, in the course of which the author states he found it "necessary to reject the kinetic theory of gases and to substitute in its place a simpler and more rational theory which is so general in its application that even gravitation is satisfactorily accounted for." E. H. B.

1773. *Recent Researches on the Structure of the Universe.* **J. C. Kapteyn.** (Nature, 78. pp. 210–212, July 2, and pp. 234–237, July 9, 1908. Discourse delivered at the Royal Inst., May 22, 1908.)

1774. *Red Spot on Jupiter.* **E. E. Barnard.** (Astronom. Nachr., No. 4272. p. 389, 1908. Nature, 78. p. 486, Sept. 17, 1908. Abstract.)—Since the earlier observations of the great red spot in 1879, 1885, and 1886 the object has somewhat altered in character; the red colour is reduced and considerably enfeebled, but there is still visible the separating stratum between the spot area and the surrounding material of the equatorial belt. C. P. B.

1775. *Search Ephemeris for Halley's Comet.* **J. Holetschek.** (Akad. Wiss. Wien, Sitz. Ber. 117. 2a. pp. 545–552, March and April, 1908.)—An ephemeris giving the probable positions of the comet at intervals of ten days for the favourable seasons during 1908, 1909, and 1910. This comet is due at perihelion in April and May, 1910. C. P. B.

LIGHT.

1776. *Absorption of Light by Hydrogen in a Vacuum Tube.* **R. Ladenburg.** (Deutsch. Phys. Gesell., Verh. 10. 14. pp. 550–561, July 30, 1908. Physikal. Inst., Breslau, July, 1908.)—Light from a tube containing hydrogen, worked by an induction coil, is passed through a similar tube also in action. The intensity of the light is measured separately for each tube and for the two together, a definite wave-length being used in each case. It is found that the sum of the two intensities is always greater than that obtained when the two tubes are worked together, *i.e.*, in the last case absorption takes place. This absorption is all the greater the longer the wave-length. R. S. W.

1777. *Influence of Naturally Active Substance on Light Reflected by it.* **K. Försterling.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 3. pp. 268–271, 1908.)—Well-known theory allows us to expect that an optically active substance will have a special influence on the light reflected from its surface, and this has already been experimentally established in several cases. The present author points out that with an *isotropic* active substance the effect is best shown when the incidence is such that one of the circular components is totally reflected and the other not. Experimenting with sodium chlorate, quartz, and Brazilian tourmaline, he finds in each case results in accord with theory. E. H. B.

1778. *Reflection from Glass at the Polarising Angle.* **Rayleigh.** (Phil. Mag. 16. pp. 444–449, Sept., 1908.)—According to Fresnel's theory the polarisation is complete when light is reflected at the Brewsterian angle ($\tan^{-1}\mu$), or, as it may be put, light vibrating in the plane of incidence is not reflected at all at the angle in question. It has long been known that this conclusion is but approximately correct. If we attempt to extinguish with a nicol sunlight reflected from ordinary glass, it is found that at no angle of incidence and reflection can we succeed. It is difficult even to fix upon an angle of minimum reflection with any precision. The interpretation of these deviations from Fresnel's laws is complicated by uncertainties as to the nature of surfaces of transition from one medium to another. It is certain that many, if not all, surfaces attract to themselves films of moisture and grease from the surrounding atmosphere, and the opinion has been widely held that, even in the absence of moisture and grease, solid bodies are still coated with films of condensed air. Other complications depend upon possible or probable residues of the polishing material used in the preparation of optical surfaces. It was mainly for these reasons that the author some years ago gave much attention to reflection from *water*, where, at any rate, there was no question of a polishing powder and atmospheric moisture could introduce no complication. It was found that Jamin's results, up to that time considered standard, were entirely vitiated by films of grease. Special operations are necessary to remove these films. When proper precautions are taken the intensity of reflection at the polarising angle may be less than one-thousandth of what Jamin observed. It appeared, however, that the cleanest surfaces were not those which gave the least reflection. At the highest degrees of purity the light again began to undergo reflection, though to a very limited amount. The effect had changed *sign*. The present paper records similar investigations with a black glass and a plate glass whose hind surface was roughened and varnished with a cement of about the same index. After polishing with rouge the glass was breathed upon and carefully wiped with a cloth. The close approach to theory in the behaviour of the glasses lost in a day or two after repolishing, was in part recovered under the operation of a careful wiping with moisture, but only to a limited extent. Full recovery required actual repolishing. It is, of course, possible that even the mild treatment by wiping may attack the very thin film of altered glass which is all that we can suppose to have been formed in so short a time; but on the whole the evidence pointed to two kinds of contamination—one removable by wiping, and the other requiring the more drastic treatment with rouge. It appeared that the full effect of wiping was easily produced and that repetition could carry the process no further. The conclusion is drawn that even a recently repolished surface, which may exhibit but small ellipticity, is in a highly complicated condition. E. H. B.

1779. *Reflection of Waves from Gradually Variable Stratum.* **J. W. Nicholson.** (Roy. Soc., Proc. Ser. A. 81. pp. 286–299, Sept. 11, 1908.)—In a variable medium the speed of propagation of a train of waves, and the wave-length at any point, are functions of the position of that point. The circumstances of such a propagation have only been worked out in detail in one particular case. Rayleigh, in connection with the transverse vibrations of a string of variable density, dealt very completely with the case in which the density is inversely proportional to the distance from a fixed point. In the original investigation the results were applied to the corresponding optical problem, and a numerical example given. Although this is perhaps the only interesting case in which a simple, exact solution appears possible, yet a close approximation may be made to the existing conditions, even in the general problem, when the waves are short in comparison with the other distances concerned. The present paper develops such a theory and examines some applications to the reflection of sound in a fog and the upward propagation of sound in the atmosphere. An appendix deals with viscosity, radiation, and conduction and their effect on sound propagation. E. H. B.

1780. *Electric Double Refraction in Carbon Disulphide.* **C. F. Hagenow.** (Phys. Rev. 27. pp. 196–208, Sept., 1908.)—The phase-difference δ in wave-lengths between the two emerging components of a beam of light which has passed between two parallel plates of length l, distance a apart and potential difference P electrostatic units, is given by $\delta = \pm P^2Bl/a^2$, where B is the electro-optical constant for the dielectric. The value of B is determined for various colours, using the Brace half-shade elliptic polarising system. A tabular summary is given of five series of observations for waves from 480 to 700 $\mu\mu$ and a curve similar to that found by Blackwell [see Abstract No. 1872 (1906)] is given. A fairly stable condition of the CS_2 for optical purposes is reached by distillation and thorough filtering. G. E. A.

1781. *Visibility Curves.* **C. S. Wright.** (Phil. Mag. 16. pp. 395–396, Sept., 1908.)—While determining with a Michelson interferometer the visibility curves from the spectral lines of some of the elements, it occurred to the author that if some standard could be used giving fringes of a known visibility and in the same position as those due to the interferometer, the method of determining the half-width would reduce to a very simple photometric determination. As the standard a mica plate was found very convenient, which was placed in the path of the light entering the interferometer, and inclined so as to give straight-line fringes perpendicular to those given by the interferometer. E. H. B.

1782. *Electro-optical Properties of Liquid Mixtures.* **J. Chaudier.** (Annal. Chim. Phys. 15. pp. 67–140, Sept., 1908.)—The author first gives a *résumé* of previous work on the changes undergone by light when it traverses a liquid situated in a magnetic field [compare Majorana, Abstracts Nos. 1844 (1902), 55, 218, 417, 418 (1903); Schmauss, Abstract No. 1854 (1903); Meslin, Abstracts Nos. 68, 740, 1381, 1384, 1667, 2019 (1904)]. The laws of electric dichroism are shown, theoretically and experimentally, to be similar to those established by Meslin (*loc. cit.*) for magnetic dichroism. But, whilst the sign of electric dichroism is independent of the relative values of the dielectric constants of the media, that of magnetic dichroism can be altered by modifying the relative values of the magnetic constants of the solid and surrounding liquid. The dichroism is proportional to the length of liquid traversed by the light and to the concentration of the liquid, and increases with the intensity of the field to a limiting value. A mixture of liquids placed in a uniform electric field exhibits marked birefraction, provided that the suspended particles are sufficiently minute. The field due to gravity is also capable of producing the phenomena of dichroism and even of birefraction. The action of any uniform field is hence manifested in an orientation of the particles of mixed active liquids, which then exhibit the phenomena of dichroism and birefraction; the laws of these phenomena are the same whatever the nature of the field, provided that account is taken of the change of sign due to diamagnetism. If the particles in suspension have a greater magnitude than about 0·3 mm. dichroism alone is observed, and is due to the reflection of light by the crystalline surfaces. If the particles are smaller and uniform in size, dichroism is still the principal phenomenon observed, but birefraction also appears and the modifications due to diffraction come into play. As the dimensions of the particles diminish, dichroism becomes rarer and birefraction plays a more important *rôle,* whilst, when they are infinitely small, as in colloidal solutions, the phenomena of reflection and refraction are no longer produced and the liquids are only birefractive. T. H. P.

1783. *Electric and Magnetic Dichroism.* **G. Meslin.** (Comptes Rendus, 146. pp. 1208–1209, June 9, 1908. Journ. de Physique, 7. pp. 856–860, Nov., 1908.)—Previously the author has shown that the sign of the magnetic dichroism of a mixed liquid is given by the sign of the expression $(n_l - n_s)$ $(N_l - N_s)$, in which n_l and n_s designate the indices of the liquid and of the solid and N_l and N_s represent coefficients relating, one to the liquid, the other to the solid. The studies of electric dichroism by J. Chaudier have recently been published [see preceding Abstract], and the law of indices applies also to this phenomenon. Meslin considers that Chaudier's results might be expressed in a way analogous to his own and the expression $n_l - n_s$ multiplied by the second factor $N_l' - N_s'$. The second expression is connected with the anisotropy of the liquor which depends on the anisotropy of the crystals. J. J. S.

1784. *Interference Fringes with Glass Wedges.* **S. R. Milner.** (Phil. Mag. 16. pp. 429–436, Sept., 1908.)—If two pieces of ordinary plate-glass of approximately the same thickness are placed one on the other, and the air-film between them is observed by sodium light, the system of Newton's fringes, formed by the interference of the light reflected from the two surfaces of the air-film, is seen. Occasionally, by very close inspection, another system of fringes may be seen which is formed by the interference of the rays which have been farther reflected from the non-adjacent faces of the plates so as to meet again at the interface. These fringes, when observed in the ordinary way, are so faint as to be only exceptionally distinguished. They will, however, become clearly visible if we cut off all the light reflected from the film except that by which they are themselves formed. The method of doing this and its application to the testing of plate-glass sheet are then explained in detail E. H. B.

1785. *Helium Light for Optical Measurements.* **H. Harting.** (Archiv f. Optik, 1. p. 97, 1907. Zeitschr. Instrumentenk. 28. pp. 273–275, Sept., 1908.)—In spectral measurements the employment of the sodium flame is subject to certain disadvantages, and the use of a helium tube and the bright helium line $\lambda 587{\cdot}7\,\mu\mu$ is recommended in place of the D-line. An interpolation formula is given for the change of refractive index with change of colour, and the change of index is calculated for all the glasses given in Schott's catalogue; it varies from 5 to 28 in the fifth decimal place. G. E. A.

1786. *The Primary Standard of Light.* **C. W. Waidner** and **G. K. Burgess.** (Electrical World, 52. pp. 625–628, Sept. 19, 1908.)—The authors classify primary standards of light under three heads: (1) Flame, (2) Vacuum tube, and (3) Incandescent surface standards. The result of numerous investigations on the flame standards used in England, France, and Germany respectively show that their inaccuracy is greater than 1 per cent., although probably less than 2 per cent. It is pointed out that, in estimating the height of the flame, two observers may consistently differ by 0·5 mm. or more, owing to the effect of the semi-luminous region above the flame. The reddish colour and low intensity of some of these flame standards, notably of the Hefner, are also unsatisfactory. It is stated that there is little prospect of finding a satisfactory flame standard. Nutting's experiments indicate that a given flux of light can be reproduced with a greater accuracy by means of vacuum-tube standards. Objections to the helium-tube standard are its pinkish colour and low intensity. They point out the great experimental difficulties in the way of adopting Steinmetz's unit consisting of three selected wave-lengths [see Abstract No. 596 (1908)]. All vacuum-tube light standards have discontinuous spectra. They are therefore unsuitable for use as spectrophotometric standards of reference. The Violle standard is taken as typical of the incandescent surface standards. The discordant results obtained by Violle and Lummer discount its value. Petavel came to the conclusion that it was constant within 1 per cent. when proper precautions were taken to avoid contamination by silicates from the crucibles and by hydrocarbons from the heating flames. W. Siemens suggested that the photometric intensity of 1 mm.^{2} of platinum ribbon at the temperature of fusion should be taken as a standard. Cross investigated a standard made of Pt-wires. Lummer and Kurlbaum proposed as the unit the intensity of the light emitted by a Pt ribbon, enclosed in a water-cooled box, maintained at such a temperature that the intensity of the total radiation after transmission through a 2-cm. water-cell with plane parallel quartz walls 1 mm. thick was 0·1 of the intensity of the total radiation. A given flux can be reproduced with a max. inaccuracy of about 1 per cent. by this standard. On account of the selective absorption of the platinum black used on the bolometer strips, it was necessary to define carefully the conditions under which this absorbing layer was deposited. Petavel has also devised somewhat similar standards, but none of them have as yet led to any definite results. Swinburne and S. P. Thompson suggested a definite area of the positive crater of the carbon arc, but Blondel's results showed variations as great as 8 per cent. The authors conclude by suggesting a new form of standard. The defect of the Violle is that it depends on the emissive power of a Pt surface. The spectral distribution of the light-intensity is changed when the surface suffers contamination. The advantages of "black-body" radiation are pointed out. A smooth surface of pure Pt at its melting-point, which is somewhere between 1,750–1,780° C., radiates only as much red ($\lambda = 0{\cdot}67\,\mu$), green ($\lambda = 0{\cdot}55\,\mu$), and blue ($\lambda - 0{\cdot}47\,\mu$), as a black body at 1,539°, 1,585°, and 1,627° respectively. Every contamination or roughness of the surface of the Pt increases its emissivity and makes its radiation approach more nearly to black-body radiation, by different amounts for each colour. It is pointed out that all the advantages of the Violle standard with regard to constancy of temperature would be retained by adopting as the unit of intensity the radiation from 1 cm.^{2} of a black body maintained at the temperature of the fusion of Pt. At the same time all the difficulties arising from selective absorption would be obviated. The unit of light, therefore, would be the intensity of the light (white or monochromatic) emitted by 1 cm.^{2} of a black body at the temperature of the solidification of Pt. From Nernst's measurements it is deduced that the intensity of this unit would be about 88 hefners, and hence its decimal subdivisions would be of convenient magnitude for comparison with the ordinary light standards.

A. R.

1787. *Photography: Solarisation.* **B. Walter.** (Ann. d. Physik, 27. 1. pp. 83–99, Sept. 25, 1908. Physikal. Staatslaborat., Hamburg, July, 1908.)—Photographic dry plates (AgBr) from different sources, even if of the same sensitiveness, differ extraordinarily in their tendency to solarise; and there is no constant ratio between the sensitiveness and the tendency to solarisation. The order of solarisabilities is different from the order of sensitivenesses, and also from the order of Clayden-effects. With different developers, with normal periods of development, the first appearance of solarisation—*i.e.*, the max. blackening—is always at approximately the same exposure for a given plate, but the amounts of blackening may differ widely. It appears that the facts are best explained by a theory on the lines of Abney's, that there are successive stages in the decomposition of bromide of silver, of which the earlier are the more developable. A. D.

1788. *Natural and Magnetic Rotation in Crystals.* **W. Voigt.** (Phys. Zeitschr. 9. pp. 585–590, Sept. 15, 1908.)—The question is taken up as to whether the magnetic rotation of the plane of polarisation is different along the axes of a biaxial crystal of which the two optic axes are crystallographically unequal. The simplest case which fulfils this condition is found among the monoclinic crystals, and an electronic theory of magnetic rotation in such crystals is sketched which shows that a difference in the magnetic rotations is admissible. Observations by K. Honda of the natural and magnetic rotation in various crystals are quoted, and it is considered that they prove with tolerable certainty the existence of a variation in the magnetic rotations along the two optic axes of cane sugar. G. E. A.

1789. *Photometric Standard of the National Physical Laboratory.* **R. T. Glazebrook.** (Electrician, 61. pp. 922–923, Sept. 25, 1908. Paper read before the British Assoc. at Dublin.)—The photometric standard of the National Physical Laboratory is a 10-c.p. Vernon Harcourt pentane lamp certified by the Gas Referees. The light given out by this lamp depends on the pressure and humidity of the atmosphere in which it is burning. It is found that there is a difference of 20 per cent. between the indications of a wet and dry bulb hygrometer and an Assmann ventilated hygrometer. If we stipulate, as recommended by the Zürich Commission, that the moisture be measured by the latter instrument, Paterson's formula becomes—

$$\text{Candle-power} = 10 + 0{\cdot}066(8 - e),$$

where e is the number of litres of moisture in 1 m.^{3} of air. Hence the standard has the value 10 c.p. when there are 8 litres of moisture per m.^{3} of air. It is proposed, therefore, to take this as the standard humidity. Liebenthal, working at the Reichsanstalt, found for the ratio of the Hefner to the standard candle the value 0·909; whilst Paterson, at the National Physical Laboratory, obtained the value 0·907. Hence—

$$(\text{Hefner candle at } 8{\cdot}8 \text{ litres})/(\text{Pentane candle at } 8{\cdot}8 \text{ litres}) = 0{\cdot}908.$$

If we accept the readings of the Assmann hygrometer and treat 8 litres as the standard condition for the pentane lamp, and 8·8 litres (the Reichsanstalt value) for the hefner, then—

$$(\text{Hefner candle at } 8{\cdot}8 \text{ litres})/(\text{Pentane candle at } 8 \text{ litres}) = 0{\cdot}903.$$

Hence for practical purposes the hefner is nine-tenths of the standard candle. Also it has been found that—

$$(\text{Bougie décimale at } 10 \text{ litres})/(\text{Pentane candle at } 8 \text{ litres}) = 1{\cdot}006,$$

and therefore for all practical purposes they are equal. The very simple relationships between the units which ensue when 8 litres per m.^{3} is taken as the standard humidity for photometry make it highly desirable that this be done. Further investigations are being made as to the cause of the outstanding small discrepancies in the values of the ratios of the units obtained by the various observers. A. R.

1790. *Fluorescence and Magnetic Rotation Spectra of Potassium Vapour.* **R. W. Wood** and **T. S. Carter.** (Phys. Rev. 27. pp. 107–116, Aug., 1908.)—An examination of the fluorescence, absorption, and magnetic rotation spectra of potassium in exactly the same way as previously done in the case of sodium [see Abstract No. 248 (1907)], the results obtained in the two cases being strikingly similar with the difference that in the case of potassium the lines are in the red region of the spectrum. E. C. C. B.

1791. *Ultra-violet Spectrum of Silicon.* **A. de Gramont** and **C. de Watteville.** (Comptes Rendus, 147. pp. 239–242, July 27, 1908.)—An examination of the ultra-violet spectrum of Si as obtained with the spark between fragments of the element in an atmosphere of H_2 and with the flame as obtained in a flame of coal-gas fed with air which has passed over some $SiCl_4$. The spectrum shows both lines and bands. In the latter case certain regularities were observed in the frequency-differences, suggesting the existence of three different series. E. C. C. B.

1792. *A Probable New Fluting in the Spectrum of Magnesium Oxide.* **E. E. Brooks.** (Nature, 78. p. 198, July 2, 1908.)—A new fluting has been observed in the magnesium oxide spectrum with heads at λλ = 4828, 4819, 4810, 4801, 4791, 4780, 4771. This is related to the known one beginning at λ = 5007.
E. C. C. B.

1793. *Spectrum of Radium Emanation.* **A. T. Cameron** and **W. Ramsay.** (Roy. Soc., Proc. Ser. A. 81. pp. 210–213, Aug. 27, 1908.)—A photographic examination of the spectrum of radium emanation between the limits λ = 7050 and λ = 3950. It was found that copper electrodes gave the best result. The probable error is about 1 Ångström unit. Rutherford and Royds's values agree very well with those given. [See Abstract No. 1415 (1908).]
E. C. C. B.

1794. *Spectrum of the Lighter Constituents of the Air.* **H. E. Watson.** (Roy. Soc., Proc. Ser. A. 81. pp. 181–194, Aug. 27, 1908.)—An examination of the lowest boiling constituents obtained by treatment of about 78,000 litres of air [see Abstract No. 589 (1907)]. The spectrum was photographed with a 10-ft. focus grating, and the values of the wave-lengths have a probable error of 0·04 A.U. except in the cases of very strong and very weak lines when the probable error is greater. The samples of gas obtained showed the presence of hydrogen, argon, helium, and neon. The wave-lengths are given between the limits of λ = 7455 and λ = 2736 after the lines of the first three gases were eliminated. Many more lines were observed than appeared in Baly's table, principally in the ultra-violet. Many of Liveing and Dewar's lines have not been seen. No evidence was obtained of the existence of any gas lighter than helium. [See Abstracts Nos. 1625 (1901) and 74 (1904).]
E. C. C. B.

1795. *Magnetic Separation of the Lines of Barium, Yttrium, Zirconium, and Osmium.* **B. E. Moore.** (Astrophys. Journ. 28. pp. 1–38, July, 1908.)—A complete study of the various types of magnetic separation as observed with the spectrum lines of Ba, Y, Zr, and Os. Very many types were noted, the separation-intervals being recorded as multiples of the standard interval, according to Runge, which is that of the normal triplet. Yttrium and Zr yield a great number of new types the most prominent characteristic of which is the number which are unrepeated in the spectral region dealt with. There is a general dissimilarity between the lines of Y and Zr, and between these and those of all substances which have yielded series. All substances, however, have common fundamental intervals of small magnitude, and few in number, intimately connected with a normal separation. E. C. C. B.

1796. *The Laws of Temperature Radiation and Distribution of Intensity in the Spectrum of the Mercury Lamp.* **A. Pflüger.** (Ann. d. Physik, 26. 4. 789–805, July 28, 1908.)—The measurements were made with a Lummer-Brodhun spectrophotometer, and also with a Rubens thermopile attached to a large spectrometer. Some difficulty was met with in separating the several radiations from one another, owing to the necessity of having the slit rather wide; in the first triplet series the fourth and sixth triplets and the first two lines of the fifth and seventh triplets were observed, while in the second series only the third triplet could be examined. The measurements of the intensity distribution with constant current showed in the case of the first series that the lines can be arranged in three series, which comprise respectively the first, second, and third members of the various triplets. Within these series the intensity decreases with decreasing wave-length, which is analogous to the intensity curve of the temperature radiation. For example, on increasing the temperature, the radiation-increase follows the same law. This relation does not hold within a single triplet, nor for the lines as a whole, that is to say, if the spectrum lines are merely arranged according to their wave-lengths. Since only one triplet of the second triplet series could be observed, it is not possible to say whether the same law holds good; but it was found that the ratio of intensities is 780 : 118 : 218, and that on increasing the temperature the first line increased more rapidly in intensity than the second, and the second rather more rapidly than the third. Thus the radiation laws do not hold good within the single triplet. Some measurements of the absorption of the glowing (ionised) vapour were also carried out, and showed that in the case of the first and third lines of the triplet of the second series the absorption increased equally for both lines with increase of current. Some observations of the absorption of the two yellow lines $\lambda\lambda = 5769$ and 5790, showed that the stronger is the less absorbed, which is opposed to Kirchhoff's law. E. C. C. B.

1797. *Relation of Light of very short Wave-length to some Vacuum-tube Phenomena.* **T. Lyman.** (Astrophys. Journ. 28. pp. 52–58, July, 1908.)—The author first deals with an investigation into the amount of radiation of very short wave-length arising from the different portions of the discharge in vacuum tubes. The test for the rays of short wave-length was their ozonising power [see Abstract No. 764 (1908)], and a piece of iodide and starch test-paper was brought up against a fluorite window. It was found that the positions of the sources of the light of short wave-length coincide with the places of luminosity in the tube, and that the intensity of the radiation may be judged by the intensity of the luminosity. The ionising power of the short-wave radiations is also dealt with, for this is of considerable importance in relation to the theory of electric conduction in a vacuum tube. That the short-wave radiations have considerable ionising power is readily shown by blowing the air from directly above the fluorite window on to a plate connected to a charged electroscope. The author considers that the ionising effect of a spark at atmospheric pressure is due both to Wiedemann's *Entladungsstrahlen* and to short-wave radiations. E. C. C. B.

1798. *Volume of Radium Emanation.* **E. Rutherford.** (Phil. Mag. 16. pp. 300–312, Aug., 1908. Paper read before the Academy of Sciences, Vienna, July 2, 1908.)—The amount of radium emanation to be obtained from 1 gm. of radium in equilibrium is shown by Rutherford's latest calculation to be 0·57 mm.^{3}, while Ramsay and Cameron found 7·07 mm.^{3}. The latter observers think that the smaller value obtained in earlier experiments is due to some of the gas being pumped off during its manipulation. It is important to know what fraction of the original emanation is actually measured; the author obtains this by finding the γ-ray activity while in the measuring tube, and comparing this with a standard radium preparation. For the methods of purification the paper should be referred to; the chief point of interest is the exceedingly great difficulty of separating the emanation from CO_2. Ramsay and Cameron's results are, no doubt, too great on that account. With impure emanation, when it is allowed to stand, the volume sometimes increases; at others, a decrease is found. This is probably due to chemical changes in the admixed gases. Pure emanation contracts to a minimum and then increases, helium appearing in the tube. Reasons are given for taking the minimum volume as the true volume, but what the initial contraction means is difficult to explain. Ramsay's suggestion that it is due to a change from a monatomic to a diatomic gas is rejected, as the amount of other gases present must have been large. Three determinations of the volume of emanation in equilibrium with 1 gm. of radium give 0·59, 0·66 and 0·58 mm.^{3}. R. S. W.

1799. *Relative Activity of the Emanation and the Active Deposit from Thorium and Actinium.* **H. L. Bronson.** (Phil. Mag. 16. pp. 291–299, Aug., 1908.)—It is usually assumed that each atom of a radio-active substance gives off, at each transformation, either one or no α-particle. This assumption is supported by experimental evidence in the case of radium, but the author proves that it does not hold for thorium and actinium. The method adopted is to compare the ionisations produced by the emanation and the active deposit when the two are in equilibrium. Emanation is drawn into a large cylindrical testing vessel for some time ,and the current measured. The emanation then decays, and the current due to the active deposit alone is found ; the difference gives the current due to the emanation. A small, calculated correction has to be applied to allow for the decay of the active deposit in the interval. The currents that should be produced can also be calculated on the assumption that the ionisation produced is proportional to the path of the corresponding α-particles. The average path of the α-particles in the vessels used is found by a graphical method. Considering the assumptions made, the values obtained are remarkably consistent. The experimental results show that the thorium active deposit is only one-quarter, and the actinium deposit only one-half as active as would be expected on theoretical grounds. These can be explained by assuming that in the case of thorium there are three products, and in the case of actinium one product, of short transformation period ; but Hahn's measurements lend no support to this view. A simpler explanation is that an atom of thorium C, in breaking up, gives off the same number of α-particles as an atom of thorium B, and that an atom of emanation gives off four times this number; also that an atom of actinium emanation, in breaking up, emits twice as many α-particles as an atom of its active deposit. R. S. W.

1800. *Secondary γ-Rays due to γ-Rays from Radium C.* **A. S. Eve.** (Phil. Mag. 16. pp. 224–234, Aug., 1908.)—Screens of iron, lead, and brick are exposed to γ-rays and the secondary radiation produced at incidence is passed into a suitable electroscope, that of the β type being absorbed before the testing instrument is reached. The radium giving rise to the primary γ-rays is enclosed either in lead or nickel steel. It is found that the primary rays traverse steel much more readily than lead, but they are subsequently much more absorbed by lead than if the radium were in lead. The reasons for considering the penetrating secondary rays to be of the γ and not of the kathode type are as follows : (1) There is a well-marked bend in the absorption curves. (2) The primary rays penetrate several cm. ; some of the secondary rays come from this depth and will then penetrate several mm. of lead. (3) The coefficient of absorption by lead is nearly the same as the coefficient of absorption by lead of the primary γ-rays of actinium. (4) The current in the electroscope is unaffected by a strong magnetic field suitably placed. R. S. W.

1801. *Number and Absorption of the β-Particles emitted by Radium.* **W. Makower.** (Elect. Engineering, 4. p. 392; Discussion, pp. 392–393, Sept. 10, 1908. Abstract of paper read before the British Assoc. at Dublin, Sept. 4, 1908.)—The author finds the number of electrons emitted by radium C in equilibrium with 1 gm. of radium to be 3×10^{10} per sec., or rather less than values previously obtained. He concludes that no β-particles are deflected or "scattered," but that they are either totally absorbed or transmitted in the original direction. In the *discussion*, **J. J. Thomson** stated that there was absolutely no doubt that β-particles were scattered by metals, as, without that, there would be no absorption; he described an experiment by Crowther showing that, with a straight beam of β-rays traversing a thin metallic film, about $\frac{9}{10}$ of the ionisation is outside the beam. **O. Lodge** distinguished between absorption by conductors and by non-conductors. Scattering would be expected in metals, and the curve of absorption should exhibit parallelism with the curve of opacity. The **Author** did not claim that his experiments were conclusive, but maintained that when β-rays are stopped they are stopped suddenly. T. H. P.

1802. *Helium in Saline Minerals.* **R. J. Strutt.** (Roy. Soc., Proc. Ser. A. 81. pp. 278–279, Sept. 11, 1908.)—Saline minerals are often comparatively free from contamination with radio-active material of the uranium-radium series. Hence they afford special opportunities of testing whether helium is generated by the other elements present, namely, Na, K, Mg, Ca, S, Cl, O, H. In this paper determinations are given of helium and radium in some of the saline minerals of Stassfurt. These minerals occur in strata of triassic age, though the age of some of them may be less, for there is evidence that secondary alterations have taken place in the salt deposits. Helium was liberated by solution of the mineral in water, and afterwards uranium was determined in the same solution, by the usual method of boiling out the radium emanation generated in a definite period. The chief results were as follows in the table:—

Mineral.	Composition.	Helium in mm.³ per 100gm.	Uranium Oxide (U_3O_8) in gm. per 100 gm.	Helium in cm.³ per gm. of U_3O_8.
Rock-salt ……	$NaCl$	0·0233	$7{\cdot}1 \times 10^{-6}$	3·3
Sylvin ………	KCl	0·55	$2{\cdot}15 \times 10^{-6}$	256
Carnallite ……	$KMgCl_3, 6H_2O$	0·151	$3{\cdot}23 \times 10^{-6}$	47
Kieserite ……	$MgSO_4, H_2O$	0·0179	$6{\cdot}47 \times 10^{-5}$	0·277

The author is disposed to trace to *potassium* the high values of helium present in sylvin and in carnallite. E. H. B.

1803. *Rate of Production of Helium from Radium.* **J. Dewar.** (Roy. Soc., Proc. Ser. A. 81. pp. 280–286, Sept. 11, 1908. Chem. News, 98. pp. 183–190, Oct. 16, 1908.)—Using 70 mgm. of radium chloride and a McLeod gauge in which no indiarubber joints were present, the author could find the rate of production of helium by the growth of pressure when all else was condensed or removed, 1 gm. of cocoanut charcoal being cooled in liquid air for maintenance of the exhaustion. The result was that helium is produced at the rate of 0·37 mm.³ per gm. of radium per day. Rutherford, in his "Radio-active Transformations" (1906, p. 186), on the theoretical assumption that the

α-particle is an atom of helium carrying twice the ionic charge, deduced from electrical measurements that the number of particles expelled per year per gm. of radium would reach 4×10^{18}; and as 1 cm.^{3} of a gas at standard temperature and pressure contains $3·6 \times 10^{19}$ molecules, the volume of helium produced per year would amount to 0·11 cm.^{3} [see, however, Abstract No. 1758 (1908)], which would be about 0·3 mm.^{3} per day, thus showing a remarkable concord of experiment and theory ! E. H. B.

REFERENCES.

1804. *Grating Spectroscope giving Direct Wave-length Readings.* **F. Löwe.** Zeitschr. Instrumentenk. 28. pp. 261–264, Sept., 1908.)—A transmission grating spectroscope with the telescope actuated by a micrometer screw which gives readings proportional to the sine of the angle through which the telescope moves. The pitch of the screw is so arranged that one complete turn corresponds to a change of 100 Ångström units. E. C. C. B.

1805. *Dispersion of Rock-salt and Sylvin in the Infra-red.* **F. Paschen.** (Ann. d. Physik, 26. 5. pp. 1029–1030, Aug. 25, 1908.)—A reply to Rubens' criticism [Abstract No. 1443 (1908)] of the author's values, and containing the latest determinations of the index of refraction of rock-salt between $\lambda(\mu)=0·589$ and 17·93. E. C. C. B.

1806. *Diffraction and Reflection derived from Maxwell's Equations.* **W. v. Ignatowsky.** (Ann. d. Physik, 26. 5. pp. 1031–1032, Aug. 25, 1908.)—Continuing the work of a previous paper [Abstract No. 420 (1908)] the author here introduces modifications in the expressions for the electric and magnetic vectors. E. H. B.

1807. *Reflection of Light by Thin Metallic Films.* **W. Voigt.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 3. pp. 284–291, 1908.)—A mathematical paper in which, on the basis of Drude's work, the author obtains formulæ for the reflection of light by a thin metallic film deposited on another metal. E. H. B.

1808. *Absorption Spectra of the Hydrocarbons Isolated from the Products of the Action of Aluminium Chloride upon Naphthalene.* **A. Homer** and **J. E. Purvis.** (Chem. Soc., Journ. 93. pp. 1319–1328, July, 1908.)

1809. *Satellites of the Yellow and Green Lines of Mercury.* **H. Nagaoka.** (Nature, 77. pp. 581–582, April 23, 1908.)—With a 35-plate echelon grating the author has noted some new satellites of the lines $\lambda=5790$ and $\lambda=5461$. E. C. C. B.

1810. *Argon as a Companion of Radio-active Zirconium Minerals.* **A. v. Antropoff.** (Zeitschr. Elektrochem. 14. pp. 585–586, Sept. 11, 1908. Paper read before the Deutsch. Bunsen-Gesell., May 30, 1908.)—On heating a Brazilian zirconium mineral containing 97 per cent. of zirconia, the author obtains a gas exhibiting a complete argon spectrum [compare Kitchin and Winterson, Abstract No. 262 (1907)]. T. H. P.

1811. *Radio-activity of Rocks in the Neighbourhood of the Simplon.* **G. Gallo.** (Accad. Lincei, Atti, 17. pp. 209–214, Sept. 6, 1908.)—The author has measured the radio-activity of 32 different specimens of rock, of which the limestone group show little, if any, activity, the maximum activity being found with the gneiss and granitic rocks. W. H. Sl.

HEAT.

1812. *Effect of Pressure on the Boiling-point of Sulphur.* **J. A. Harker** and **F. P. Sexton.** (Elect. Rev. 63. pp. 416–417, Sept. 11, 1908. Paper read before the British Assoc., at Dublin.)—The boiling-point of sulphur is used in the determination of the characteristic constant, δ, of the particular kind of wire employed in a Pt-resistance thermometer. The authors give the results of a redetermination of the effect of variation of pressure on the boiling-point of sulphur, the limits of pressure employed lying well outside the usual atmospheric limits. The numbers obtained are closely represented by the formula; $T = T_s + 0{\cdot}0904\,(p - 760) - 0{\cdot}0000519\,(p - 760)^2$, where T is the temperature of the vapour on the air scale at the pressure p mm., and T_s the normal boiling-point. Thus the effect decreases fairly rapidly with rise of pressure and is much greater than the value usually employed, namely, 0·082 mm. per degree, which was deduced from Regnault's observations. The use of this latter value may lead to appreciable errors in the determinations of high temperatures. T. H. P.

1813. *Liquid above the Critical Temperature.* **W. P. Bradley, A. W. Browne,** and **C. F. Hale.** (Phys. Rev. 27. pp. 90–106, Aug., 1908.)—When the pressure in the wide compression tube of a Cailletet apparatus, filled with pure CO_2, is slowly increased, the temperature being kept below the critical temperature, ripples are seen to flow down the sides of the tube. These show no discontinuity above the critical temperature, and may be observed at temperatures up to 38° C., and probably higher. Ripples or striæ, which flow upwards and have no tendency to adhere to glass, are also formed at temperatures above the critical temperature, when the volume is slightly increased, after having been first compressed till the downward ripples appeared. Below the critical temperature these upward ripples are replaced by bubbles rising to the meniscus. The paper concludes with a *résumé* of the evidence in favour of the existence of liquid above the critical temperature, and the only theory which includes all the facts is considered to be that which assumes that at the critical temperature the miscibility of liquid and vapour ceases to be limited. [See also Abstract No. 1448 (1908).] W. H. Si.

1814. *Latest Advance towards Absolute Zero.* **F. Hyndman.** (Engineering, 86. pp. 261–262, Aug. 28, 1908. Nature, 78. pp. 370–372, Aug. 20, 1908. Taken from the Proceedings of the Roy. Acad. of Amsterdam.)—The author gives a description of the means employed by H. Kamerlingh Onnes to liquefy helium [see Abstract No. 1817 (1908)]. Gaseous helium at about 15° absolute was expanded from 200 to 40 atmos. The liquid helium appears to have a negligible capillarity at its boiling-point, an observation which is in keeping with the proximity of the boiling-point to the critical temperature. The following are the physical constants of helium: inversion point, about 40° C.; Boyle Point, about 20° abs.; critical point, about 5° abs.; boiling-point, 4·5° abs.; freezing-point, below 3° abs.; critical pressure, 2·3 atmos.; triple-point pressure, less than 7 mm.; ratio of critical temperature to critical pressure, 2·2; ratio of density of vapour to that of liquid, 1/11; density of liquid at boiling-point, 0·15. T. H. P.

1815. *Ionisation from Hot Bodies applied to Thermometry.* **O. W. Richardson.** (Phys. Rev. 27. pp. 188–195, Sept., 1908.)—It is proposed to carry out high-temperature measurements by means of the relation given by the author in a previous paper [Abstract No. 1489 (1904)]. If i is the saturation current per unit area of the hot metal at any absolute temperature θ, then $\log i - \frac{1}{2}\log\theta = A - b/\theta$, where A and b are constants. It is proposed to determine simultaneously the resistance and the value of i for the hot metal up to 1,500° C., and to construct the diagram giving the linear relation between $\log i - \frac{1}{2}\log\theta$ and $1/\theta$ for values of θ up to 1,778° abs., and by a method of extrapolation to obtain θ. A second method is suggested which consists in measuring the kinetic energy of the ions emitted by the hot metal. Its theory is outlined, the mode of application consisting in the measurement of the back e.m.f. caused by charging one plate from another placed parallel to it and containing in its plane a strip of the hot metal. It is not professed that either of the methods outlined could be applied at once with absolute confidence in the results. G. E. A.

1816. *Origin of the Brownian Movement.* **J. Perrin.** (Comptes Rendus, 147. pp. 530–532, Sept. 21, 1908.)—A continuation of earlier work on the subject (ibid. 146. pp. 967–970, May 11, and 147. pp. 475–476, Sept. 7). The author has measured the radius, density and concentration at different heights of the granules in emulsions of gamboge gum, and finds that for dilute emulsions the concentration decreases as an exponential function of the height. In dilute emulsions the osmotic pressure due to the Brownian movement is proportional to the concentration, *i.e.*, to kn, n being the concentration and k a constant, independent of the nature of the granules, and having a calculated value of about 40×10^{-15}. The author's experiments with emulsions of different strengths give values for k of $42{\cdot}5 \times 10^{-15}$, $40{\cdot}4 \times 10^{-15}$, and $44{\cdot}1 \times 10^{-15}$, and the close agreement of these with the theoretical figure is regarded as confirming the accuracy of the kinetic theory of the Brownian movement. These experiments furnish a new and more precise method for determining the number of molecules contained in one gm.-molecule of any substance, and hence the charge of the atom of electricity or corpuscle.

W. H. St.

REFERENCES.

1817. *Liquefaction of Helium.* **H. Kamerlingh Onnes.** (Konink. Akad. Wetensch. Amsterdam, Proc. 11. pp. 168–185, Sept. 8, 1908.)—Details of the method and plans of the apparatus employed for liquefying helium are given [see Hyndman, Abstract No. 1814 (1908)]. T. H. P.

1818. *On the Mixing of Gases.* **S. H. Burbury.** (Phil. Mag. 15. p. 768, June, 1908.)—In reply to Orr's letter [Abstract No. 826 (1908)] the author maintains that, if the kinetic theory of gases be true, then no irreversible motion is possible among the molecules of a gas completely protected from the influence of external bodies.

A. R.

1819. *Calculation of the Pressure of a Mixture of Two Gases by Gibbs' Statistical Mechanics.* **L. S. Ornstein.** (Konink. Akad. Wetensch. Amsterdam, Proc. 11. pp. 116–122, Sept. 8, 1908.)

1820. *On Methods of obtaining Cooling Curves.* **G. K. Burgess.** (Electrochem. Ind., N.Y. 6. pp. 366–371, Sept., and pp. 403–405, Oct., 1908.)—Methods of Thermal analysis; Temperature-time curves; Differential curves; Direct and inverse rate curves; Rapid cooling; Characteristics of cooling curves.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

1821. *Size of Molecules and Charge of Electrons.* **J. Perrin.** (Comptes Rendus, 147. pp. 594–596, Oct. 5, 1908.)—The number N of molecules in a gm.-molecule, the charge e of an electron, and the quotient α of the mean energy of a molecule by its absolute temperature are universal constants which are all known as soon as one of them is known. Since, in the electrolysis of a monovalent salt, 96,550 coulombs are transported by N atoms, we have—

$$\mathrm{N}e = 3 \times 10^{9} \times 96{,}550 = 29 \times 10^{13} \text{ c.g.s. electrostatic units} \ldots\ldots (1).$$

Again, by kinetic theory, we have $3\mathrm{RT}/2$ as the measure of the kinetic energy of the N molecules, thus—

$$2\mathrm{N}\alpha = 3\mathrm{R} = 3 \times 83{\cdot}2 \times 10^{6} \ldots\ldots (2).$$

Various estimates have been made of N. Thus, from the theory of van der Waals, which makes the *true* volume of N molecules the one-twelfth of the critical volume of the gm.-molecule, the result follows—

$$\mathrm{N} = 60 \times 10^{22} \ldots\ldots (3).$$

The values found by the experiments on ions as nuclei by C. T. R. Wilson, and kindred work by Townsend, H. A. Wilson, and J. J. Thomson, give values lying between—

$$\mathrm{N} = (43 \text{ to } 96) \times 10^{22} \ldots\ldots (4).$$

From the experiments of Kurlbaum on black radiation and the electromagnetic theory of it due to M. Planck, α has the value $2{\cdot}02 \times 10^{-16}$, which gives—

$$\mathrm{N} = 61 \times 10^{22} \ldots\ldots (5),$$

whereas by a different theory H. A. Lorentz finds from the same experiments—

$$\mathrm{N} = 77 \times 10^{22} \ldots\ldots (6).$$

The present author, to determine N, followed a method which is direct and is susceptible of high accuracy. It is founded upon the fact that equal grains in a weak emulsion distribute themselves as if made of molecules of the same mass and obeying the laws of a perfect gas. This involves the equation—

$$2{\cdot}3 \log_{10} \frac{n_0}{n} = \frac{\mathrm{N}}{\mathrm{RT}} \frac{4}{3} \pi a^3 (d - \sigma) h \ldots\ldots (7),$$

where n and n_0 denote the concentration of the grains in the plane at distance h, a is the radius of the grains, and $(d - \sigma)$ the excess of their density over that of the water. Three series of experiments showed that grains of very different sizes lead to practically the same value of N. The author's final results by this method are—

$$\mathrm{N} = 71 \times 10^{22},\ e = 4{\cdot}1 \times 10^{-10}, \text{ and } \alpha = 1{\cdot}7 \times 10^{-16} \ldots\ldots (8).$$

E. H. B.

1822. *Further Note on the Glow generated by Electrostatic Induction in an exhausted Silica Vessel.* **F. J. Jervis-Smith.** (Roy. Soc., Proc. Ser. A. 81. pp. 214–216, Aug. 27, 1908.)—An extension of some experiments described in a previous paper [see Abstract No. 844 (1908)]. A silica glow-bulb exhausted to a Röntgen vacuum was placed about 0·5 cm. from a disc-shaped terminal of an induction coil. By adjusting the distance of the other electrode, which was a point, a brush discharge was made to play over the bulb. A brilliant emerald-green glow was developed in the bulb, lasting about 15 min. after the discharge had been stopped. No glass bulbs exhibit the after-glow. A silica bulb was slowly rotated with a portion of the bulb in contact with dry mercury in a dish, and a bright glow was developed. An efficient electrical machine can be made by rotating the bulb in contact with mercury and collecting the electricity by means of a metal brush in light contact with the bulb about 1·5 cm. above the mercury. E. C. C. B.

1823. *Vertical Electric Current in the Atmosphere, July 26, 1907.* **D. A. Smirnov.** (Acad. Sci. St. Pétersbourg, Bull. 9. pp. 759–774, May 15, 1908.) —This paper gives the results of electrical observations made during balloon ascents from St. Petersburg. In general, the strength of field at any part of the field is found to be inversely proportional to the conductivity of the air. The concentration of the positive ions near the ground is found to be greater than that of the negative ions, the value of $\lambda = \lambda_+ + \lambda_-$ varying from 146×10^{-6} to 240×10^{-6} electrostatic units, values of the same order as those observed in Pawlowsk on July 24, when the mean values obtained for λ_+ and λ_- were 110×10^{-6} and 86×10^{-6}. But above the ground the opposite is the case, the mean values observed for λ_+ and λ_- being 159×10^{-6} and 194×10^{-6} respectively. At a height of 700 m. the free electricity was found to have the mean value $\rho = 8{\cdot}4 \times 10^{-9}$ electrostatic units per cm.^{3} [compare Gerdien, Abstracts Nos. 2078, 2237 (1905)]. The mean magnitude of the current density found was $1{\cdot}17 \times 10^{-7}$ electrostatic units per cm.^{2} ($3{\cdot}9 \times 10^{-7}$ amp. per sq. km.). The variation of the density of current with the height is discussed. T. H. P.

DISCHARGE AND OSCILLATIONS.

1824. *Temperature-changes due to Emission of Electrons from Hot Bodies.* **A. Wehnelt** and **F. Jentzsch.** (Deutsch. Phys. Gesell., Verh. 10. 17. pp. 605–614, Sept. 15, 1908.)—If a glowing body is suddenly brought into an electric field, theory indicates that when electrons are removed from it a certain amount of energy, U, is lost and the body should be cooled. For example, if a wire is heated by an electric current and its temperature maintained constant, then the necessary current i on the application of the field must increase by the amount Δi, so that if w is the resistance of the wire $U = (i + \Delta i)^2 w - i^2 w$, or $\Delta i = U/2iw$. On experimental investigation of this theoretical effect in the actual pressure conditions of the tube—a glowing Pt wire coated with CaO inside a coaxial brass cylinder—first of all the directly contrary phenomenon was observed: on application of the field the wire became heated; to maintain the temperature constant a less heating current than before was required; only later could the required cooling be observed. Investigation shows that the explanation of the observed behaviour is that the electrons accelerated by the field ionise the gas residue by collision, and the resulting positive ions, which after traversing a great part of the field have acquired a certain kinetic energy, arrive at the wire and cause its temperature to rise. Even with the smallest attainable pressures the moving electrons are yet able to ionise the gas residue, so that with the so-called saturation-current curves there never occurs the pure non-self-sustaining, but always the mixed non-self-sustaining current. J. J. S.

1825. *Kinetic Energy of the Negative Electrons emitted by Hot Bodies.* **O. W. Richardson** and **F. C. Brown.** (Phil. Mag. 16. pp. 353–376, Sept., 1908.)—The results are given of an investigation of the portion of the kinetic energy of the electrons emitted by hot metal, which depends upon the component of the velocity normal to the emitting surface. Both the average value of this portion of the energy and the law according to which it is distributed among the different particles given off are examined. The method employed gives no information about the part of the energy which depends on the component of velocity parallel to the surface of emission. The method used consisted in measuring the rate at which an insulated plate A charged up when a portion of another plate B parallel to A was made of metal sufficiently hot to emit ions. As the metal in B emits negative ions the plate A becomes negatively charged, so that a p.d. is established tending to stop the flow of electricity. From the way in which the current between the two plates varies with the time or with the p.d. between them the quantity investigated is obtained. In the centre of the lower of the two circular plates used, which was joined to earth, was a square hole, and into this a portion of a narrow Pt strip was bent so as to be flush with the surface of the plate. This strip was heated by a current, and the middle point of the exposed portion of the hot strip was kept at zero potential. The upper plate joined to an electrometer faced the lower at a distance of 2 mm. The plates were kept in an enclosure in which the pressure of the air in the different experiments varied from 0·001 to 0·06 mm. The authors consider that the reasonable view to take of the results obtained is that the current is carried by discrete charged particles whose motion after they have left the plate is determined solely by the magnitude of the electric field and their initial velocity. The distribution of velocity among the particles emitted from the hot metal at any instant has been examined, and it is shown that, in the case of Pt at least, the results are consistent with what would be required if in the state of statistical equilibrium the distribution of velocity among the electrons outside the metal were determined by Maxwell's law. This leads to a strong presumption that the distribution of velocity among the external electrons in the steady state would be given by Maxwell's law, with the mean translational kinetic energy identical with that of the molecules of a gas at the temperature of the metal. This involves the further conclusion that the distribution of velocity among the free electrons inside the metal is also determined by Maxwell's law. J. J. S.

1826. *Fluorescent Sodium Vapour.* **H. Zickendraht.** (Phys. Zeitschr. 9. pp. 593–603, Sept. 15, 1908. Physikal. Inst. d. Univ., Basel, July, 1908.)—A study of the behaviour of the vapour when present in a vacuum tube along with air or some other gas, Wood's method of producing sodium vapour being employed [see Abstract No. 2177 (1905)]. The temperature at which fluorescence appears is about 300°, but seems to depend in some way on the pressure of the surrounding gas. In three series of observations in which the pressure and electrode-distance were kept constant while the temperature was slowly changed and the voltage slowly increased until a discharge took place, two minima are obtained for the sparking potential. For the first of these no optical meaning has been found, but the second is considered to mark the instant at which the green fluorescence appears. With the gases H, CO_2, and N the fluorescence could not be made to disappear for any length of time; no discharge took place in H at a voltage of 400; and of all the gases CO_2 exhibits the minimum point most clearly. The characteristics of the mixture, sodium vapour-air are then considered as to their dependence on the five variables, pressure, temperature, electrode distance, voltage, and current intensity. G. E. A.

1827. *Velocity of Ions emitted by a Plate under the Influence of Light.* **E. Ladenburg** and **K. Markau.** (Deutsch. Phys. Gesell., Verh. 10. 14. pp. 562–577, July 30, 1908. Physikal. Inst. d. Univ., Berlin, June, 1908.)—It is usually supposed that the velocity of the ions emitted under these conditions varies from zero to a maximum. The experiments here described show that the velocity varies with the wave-length of the light used, and that the distribution of velocities takes place according to Maxwell's law. Specifying the velocity of the ions by the positive voltage necessary to stop their escape from the plate, for light of wave-length about 260 $\mu\mu$ the limits of velocity are 0·4 — 1·9 volts. The authors conclude that the light-electric effect is purely a resonance phenomenon. R. S. W.

1828. *Genesis of Ions by Collision of Positive and Negative Ions in Argon and Helium.* **E. W. B. Gill** and **F. B. Pidduck.** (Phil. Mag. 16. pp. 280–290, Aug., 1908.)—Townsend's theory shows that the sparking potential can be calculated if the number of new ions produced by a positive and negative ion under the conditions of the experiment is known. The authors have tested this theory for the gases argon and helium, and have found a satisfactory agreement with experiment. R. S. W.

1829. *Decay Constant of Ions.* **C. Barus.** (Amer. Journ. Sci. 26. pp. 324–328, Oct., 1908.)—An investigation of the value of Thomson's constant e based on the decay constant, $1{\cdot}1 \times 10^{-6}$, of the ions [see Abstract No. 1652 (1908)]. In the experiments the fog chamber itself was made an electrical condenser. The values of e found varied from $5{\cdot}1 \times 10^{10}$ to $2{\cdot}5 \times 10^{10}$. The too large values were probably caused by γ-ray penetration. Both positive and negative ions must have been caught in the fog chamber. The chief purpose of the experiments was to test the standardisation of the fog chamber in terms of coronas and the degree to which positive and negative ions may be caught even at very high nucleation. J. J. S.

1830. *Formation of Gas in Vacuum Tubes.* **R. v. Hirsch.** (Phys. Zeitschr. 9. pp. 603–606, Sept. 15, 1908.)—Experiments are made which identify the gas evolved from Al electrodes by the action of electric discharge [see Abstract No. 442 (1908)] as a mixture of H and CO_2. Further, the p^2V value of pure CO_2 is nearly 1/22 of the H value; thus the relation to the molecular weight previously found for H_2 and N_2 holds here also. A curve is given showing the variation of p^2V from constancy for H and CO_2 as the mixture changes from pure H to pure CO_2; it has pronounced maxima corresponding to mixtures in which one constituent greatly preponderates. A strong minimum value of p^2V is obtained for a mixture containing from 44 to 52 per cent. of H. This critical mixture is formed by the discharge itself if the two gases are present in the tube, but the same condition is not found in mixtures of other gases. The peculiarity of the $H\text{-}CO_2$ mixture is compared with the eutectic point of melting or boiling mixtures. [See also Abstract No. 1552 (1907).] G. E. A.

1831. *Difference of Metal Potentials in Explosive Flames.* **De Muynck.** (Annal. Soc. Sci. de Bruxelles, 32. 3 and 4. pp. 199–215, 1907–1908.)—The author modifies his apparatus [see Abstract No. 1290 (1908)] in order to study explosion of mixtures of hydrogen and oxygen instead of CO and O. Observing discrepancies from the former results he repeated the CO experiments with the new apparatus of H-form; the ignition spark is produced in a smaller vessel communicating with the H. Attention is drawn to a certain connection between the colour of the flame and the galvanometer deflection. In a succession of explosions the flame first appears red and then turns blue; but the colours are not symmetrical in the different parts of the H-vessel, which itself is not symmetrical. In the mixtures of hydrogen and oxygen (or air) the order of the metals is, in general, Cu, Fe, brass, Pb, Al, Zn, as in the CO mixtures. This is the Voltaic series, except that Al and Zn change places. Impurities and the polish of the metals are of influence and may also account for the behaviour of Al. H. B.

1832. *Electrical Resistance of Spark-gaps.* **R. A. Houstoun.** (Roy. Soc. Edinburgh, Proc. 28. pp. 369–373, 1908.)—The author points out that hitherto spark-resistances have been measured by Slaby's method of using an additional spark-gap; he, on the other hand, has taken resonance curves and has thus determined the logarithmic decrements with electrodes of various metals. The decrements were calculated from Drude's formula. The greatest decrements observed were with electrodes of Al, and the least with brass, the decrement in the latter case being about 50 per cent. less than in the former. Several types of break were used on the induction coils employed to produce the current, the most regular results being obtained from a motor-driven brass wheel, in the rim of which pieces of slate has been set, against which a platinum spring was pressed. The decrease of decrement with increase of length of spark-gap was very striking in the case of Al and Ni. In the case of Zn the decrement decreases to a minimum and then increases again, and this is probably true for the others beyond the limits of the experiments. J. E.-M.

1833. *Electric Arc between similar Electrodes as Rectifier.* **J. Sahulka.** (Elektrotechn. Zeitschr. 29. pp. 949–950, Oct. 1, 1908. Communication from the Elektrot. Inst. d. techn. Hochschule, Wien.)—The author describes experiments in continuation of some earlier ones of his of 1894, in which a rectification was observed when the electrodes used were of unequal dimensions. In the present case a 4-mm. carbon bears against a carbon disc 9 cm. in diam., rotated several times per sec. Using current at 220 volts 50 $\sim$, the rectified energy amounted to 297, 375, and 408 volt-amps. in three experiments, the efficiency in the three cases being 28, 31, and 28 per cent. with respect to the watts supplied. Outside the arc, the direct current flows from the rod to the disc, the hot rod being thus charged positively with respect to the cooler disc. L. H. W.

1834. *Absorption of Short Electric Waves by Air.* **J. E. Ives** and **R. E. C. Gowdy.** (Phys. Rev. 26. pp. 196–197, Feb., 1908. Abstract of paper read before the Amer. Physical Soc. Electrician, 61. p. 524, July 17, 1908.)—The waves were generated by an oscillator of the Righi type, consisting of two Pt cylinders each 25 mm. long, and 2·5 mm. in diam., sealed into glass tubes. The resonator was of Klemenčič's type, and a thermoelectric junction was used as indicator. Between the oscillator and resonator was a glass tube 44·5 cm. long and 10 cm. diam. closed at the ends with pieces of plate glass. A Geryk pump was connected to the tube. For pressures ranging from atmospheric to 0·5 mm. of mercury, there are two pressures which give maximum absorption, and at least one which gives a minimum. The maxima are about 50 cm. mercury, and not far from zero pressure; the minimum is about 30 cm. of mercury. Quite near zero pressure the absorption diminishes rapidly. The actual absorption of energy was about 0·15 per cent. per cm. of length of the tube. At the minimum the absorption was less than at atmospheric pressure. J. E.-M.

1835. *Hertz Reflection Experiments by means of the Duddell Arc.* **N. Stschodro.** (Ann. d. Physik, 27. 1. pp. 225–228, Sept. 25, 1908. Physikal. Inst. der Univ., Moskau, June, 1908.)—The author employs a Duddell arc with cooled electrode to excite a Hertz oscillator. He thus reaches a frequency of oscillation 500 times that reached by Poulsen. One of the two metal cylinders, which form the oscillator, is cooled by internal water circulation. The arc is formed between the copper end of the cooled cylinder and a silver point fixed in an adjustable manner into the other cylinder. A 500-volt continuous-current dynamo feeds the arc through suitable resistances, choking-coils confining the oscillations to the oscillator. A current of about 0·7 amp., with an arc of 0·5 mm. gives best results. If the silver point is anode the oscillations are more intense. Resonators with thermo-couples serve as detectors and Hertz cylindrical mirrors are used to direct and concentrate the waves. A wire-grating experiment shows the polarisation of the waves, and the wave-length is found by Boltzmann interference-mirrors to be a little over 60 cm. T. P. B.

1836. *Propagation of Plane Electromagnetic Waves along a Stratified Conductor with Special Reference to the Conditions of Wireless Telegraphy.* **F. Hack.** (Ann. d. Physik, 27. 1. pp. 43–63, Sept. 25, 1908.)—This paper arises out of one by Zenneck, which considered the form of radio-telegraphic waves as they pass along the surface of a homogeneous conductor [see Abstract No. 2095 (1907)]. It deals with the form of the waves, when the conductor consists of two layers of widely different conductivities and dielectric constants. After the solution of the Maxwellian equations is obtained for the three media, the values mentioned below are given to the constants, and so the form of the waves found. The first case considered is that of a layer of wet earth (dielectric constant $= \epsilon = 15$, conductivity $= \sigma = 10^{-12}$ c.g.s. units) with dry ground beneath it ($\epsilon = 2$, $\sigma = 10^{-16}$). The wave-length considered, λ, varies from 800 m. to 2,000 m., and the thickness of the layer of wet earth, T, from 0 cm. to 50 cm. It is found that, when $T = 0$, the electric field in the air has a considerable horizontal component, especially when λ is large, and this component is not in phase with the vertical; *i.e.*, there is in the air a rotating field of which the max. amplitude makes a considerable angle with the vertical. As T increases, the field becomes more and more a true alternating field slightly less inclined to the vertical. In the layer of wet earth there is a true alternating field in a horizontal direction. Curves are given showing the absorption in the air and in the wet layer. The following conclusions are drawn as important for wireless telegraphy. (1) With regard to absorption in the direction of propagation a wet earth surface is throughout advantageous, especially for stations working with short wave-lengths. (2) The wet layer changes the rotating electric field into an almost pure alternating field. A layer of snow is shown to act in the same manner as the wet earth layer. The second case considered is that of dry land ($\epsilon = 2$, $\sigma = 10^{-16}$) over underground water ($\epsilon = 80$, $\sigma = 5 \times 10^{-14}$). T is given values between 0 and 100 m. It is found that the underground water makes the direction of the field coincide much more nearly with the vertical, but the further it is from the surface the greater becomes the rotating field component, especially for short wave-lengths. The absorption is considered as before, and the following conclusion given : Underground water affects very favourably the working of long-wave stations, especially with regard to absorption in the direction of propagation. On the other hand, it may increase the absorption for short waves, and in any case it increases considerably the rotating field component in such waves. A brief consideration of a second layer of dry earth beneath a moderate depth of underground water concludes the paper. T. P. B.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

1837. *Constancy of Thermo-elements.* **E. Lecher.** (Akad. Wiss. Wien, Sitz. Ber. 117. 2a. pp. 873–876, March and April, 1908. From the physikal. Inst. d. k.k. deutsch. Univ., Prag.)—The combinations Fe-Pt, Fe-Cu, Fe-Ni, and Fe-constantan were maintained at a temperature of approximately 500° C. for a period of about 7½ months by means of a powerful gas-flame. Their e.m.f. was tested from time to time by means of a millivoltmeter and compared with a similar element in each case. It was found that the e.m.f. remained constant, the changes observed being only slight. J. J. S.

1838. *Thermo-electricity of Cobalt.* **H. Pécheux.** (Comptes Rendus, 147. pp. 532–533, Sept. 21, 1908.)—The thermoelectric e.m.f. of a cobalt-copper couple has been measured from 0° to 900° C. The curve of the e.m.f. forms three well-defined parabolic sections, from 20° to 280°, from 280° to 550°, and from 550° to 900° respectively. Cobalt, therefore, undergoes molecular transformation at 280° and 550°. From 900° to 1,040° the e.m.f. continues to vary parabolically. W. H. Si.

1839. *Wehnelt Interrupter.* **P. Bary.** (Comptes Rendus, 147. pp. 570–571, Sept. 28, 1908.)—The author's study of the phenomena of electromagnetic striction [see Abstract No. 1086 (1907)] has led him to formulate a theory of the action of the Wehnelt interrupter, which he has found a help in predetermining the effects produced by varying the relative sizes, &c., of parts of the interrupter. The pressure P inside a liquid conductor of cylindrical form, carrying a current of high intensity, is given by $4I^2/\pi d^2$, where I is the current and d the diam. of the conductor. In the orifice of the Simon type of this interrupter, when the current I is approaching its max. value, the rapidly increasing pressure drives back the liquid so quickly that before it can be replaced a space filled with vapours is formed and there is an interruption of the current accompanied by a spark. When the current stops the liquid at once fills up the space, and the current again forming, the cycle of operations is repeated. If H be the external pressure on the liquid at the level of the orifice and P the pressure of the vapour at the temperature during the experiment, we may suppose that the current I required to produce interruption is given by the formula $I = (\pi d^2/4a)(H - P)$, where a is a constant depending on the interrupter used. The time t required for the current to attain the value I is, by Helmholtz's formula, given by $I = (E/R)(1 - e^{-Rt/L})$. Hence, if we suppose that the time which the rupture lasts is appreciably small, the frequency of the interruptions is given by—

$$f = (R/L)/\log_e\{E/[E - AR(H - P)]\},$$

where A is a constant and R, L, E are the resistance, inductance and e.m.f. in the circuit. The curves of Wehnelt and Donath show that the time of rupture is only negligible when f is comparatively small. In other cases the true frequency is $f/(1 + bf)$, where b is the time of rupture, which is a constant for a given instrument working at a fixed temperature. The theory is in accord with experiment, and so Blondel's analogy of the working of a Wehnelt interrupter with that of a hydraulic ram or a pulsometer is justified. A. R.

1840. *Self-inductance of Solenoids.* **H. Nagaoka.** (Mathematico-Physical Soc., Tōkyō, Proc. 4. 16. pp. 314–325, May, 1908.)—Lorenz's formula for the self-inductance L of a solenoid is deduced from the author's formula for the mutual inductance of two coaxial solenoids [Abstract No. 272 (1908)]. The author expresses this formula in the form $L = 4\pi n^2 \times$ (area of cross-section of coil) $\times \lambda$. Various power series are obtained for λ. When the length of the coil is greater than the diam. the first four terms of the series gives Russell's formula [see also Havelock, Abstract No. 678 (1908)]. The author shows how to find Jacobi q series for Lorenz's formula by means of which its value can be computed very easily to any desired accuracy. In conclusion, tables are given of the values of $\log_{10}\lambda$ and λ to seven and six significant figures respectively. Columns of the first and second differences are also given, and as the second differences are small, the interpolation formulæ can be easily applied. A. R.

1841. *Calculation of Mutual- and Self-inductance.* **E. B. Rosa** and **L. Cohen.** (Bureau of Standards, Bull. 5. pp. 1–132, Aug., 1908.)—A *résumé* is given of the formulæ that have been suggested for calculating the mutual- and self-inductance of coils of various shapes. Most of the formulæ have been given in previous papers by the authors, but they are now collected, and their relative accuracy and the labour involved in computing them are compared. Numerical examples are worked out to illustrate and test the formulæ, and fourteen useful tables are given in an appendix. The Lorenz formula [see preceding Abstract] for the self-inductance of a helical current is given in the form $L = an^2Q$, where a is the radius of the cross-section of the cylinder on which the helix lies, n is the total number of turns and Q is a function of $2a/h$, h being the length of the helix. The values of Q for values of $2a/h$ lying between 0·20 and 4·00 are tabulated. Hence the self-inductance in cm. can be written down at once. [In Russell's second formula [87], given on p. 28 of this paper, a misprint in the original paper is uncorrected. The second term given should be divided by c^2, where $c^2 = 4Aa/(A + a)^2$. The factor, therefore should be $2\pi(A + a)/8$, and not $8\pi Aa/\{8(A + a)\}$.] A. R.

1842. *Compensation for Self-inductance in Shunt Resistances.* **A. Campbell.** (Electrician, 61. pp. 1000–1001, Oct. 9, 1908. From the National Physical Laboratory.)—The device consists in making the leads from the potential points, of shape similar to that of the shunt, and running one or both so as to be almost coincident in position with the shunt itself. With such an arrangement the p.d. obtained will be, in magnitude and phase, almost exactly what the shunt would give if it were non-inductive. The general explanation of this lies in the fact that the magnetic field due to the current in the shunt, while it causes the back e.m.f. of self-inductance in the shunt, causes at the same time an equal and opposite e.m.f. of mutual inductance in the potential leads, and the result is the non-inductive condition desired.

F. E. S.

1843. *The Variation of Manganin Resistances with Atmospheric Humidity.* **F. E. Smith.** (Phil Mag. 16. pp. 450–456, Sept., 1908. From the National Physical Laboratory. Electrician, 62. pp. 222–224, Nov. 20, 1908.)—The results of measurements on the changes in the resistance of the manganin standards of the National Physical Laboratory are given. The following table is typical of the results obtained :—

Coil.	Nominal Value.	Atmosphere dried with P_2O_5 for—					Atmosphere saturated with water for—						Change.
		3 days.	4 days.	5 days.	6 days.	10 days.	2 days.	4 days.	6 days.	10 days.	18 days.	24 days.	
	ohms.												
L. 19	10	−15	−16	−18	−17	−18	+ 2	+ 3	+ 6	+18	+28	+28	+41
L. 143	10	− 1	− 2	− 2	− 4	− 3	+23	+36	+38	+38	+36	+37	+40
L. 140	100	− 9	−13	−17	−14	−16	+20	+25	+38	+40	+48	+48	+64
L. 139	1,000	− 3	− 2	− 2	− 1	− 2	+16	+17	+30	+35	+35	+37	+39
2449	1,000	− 2	− 2	− 4	− 2	− 3	+ 6	+ 8	+ 8	+ 9	+11	+11	+14

The value of the resistance in air having a relative humidity of about 60 per cent. at 17° C. is taken as the unit, and the variations from this value when the coils were placed in atmospheres approximately dry and approximately saturated are given in parts in 100,000. The first four coils were made by Melsom and the last by O. Wolff. The table gives positive evidence of changes in standards of the best construction. The fact that the coil made by Wolff is less affected by humidity than those made by Melsom points either to a difference in the shellac varnishes employed, or to an effect due to the ageing of the varnish, or both. The changes given in the table are comparable with those observed by Rosa and Babcock [see Abstracts Nos. 1892 (1907) and 123 (1908)]. Experiments are also described showing the effect of humidity on the resistance of the coils in resistance boxes made by Nalder Bros., Paul, and Wolff. In some cases the variation in the value was due to the leakage of current across a thin film of moisture which formed on the surface of the ebonite. The observations, taken as a whole, support the conclusions arrived at by Rosa and Babcock, that coils when hermetically sealed or coated with a varnish which does not absorb moisture exhibit the "humidity effect" to a negligible extent only. The possibility of a shellac varnish being made which will not be appreciably hygroscopic is pointed out. [See also Abstract No. 1678 (1908).] A. R.

ALTERNATING CURRENTS AND MAGNETISM.

1844. *Effective Resistance and Reactance of Solenoid having a conducting Magnetic Core.* **F. Piola.** (Atti dell' Assoc. Elettr. Ital. 12. pp. 497–515, July–Aug., 1908.)—Assuming the distribution of flux in the core of the solenoid previously calculated [see Abstract No. 474 (1907)], the author proceeds to determine the effective resistance and reactance of the solenoid, and he shows that the results obtained by Battelli and Magri for the particular cases of low frequencies and very high frequencies [Abstract No. 1762 (1906)] follow from his more general formulæ. S. G. S.

1845. *Reversible Permeability of Iron.* **R. Gans.** (Ann. d. Physik, 27. 1. pp. 1–42, Sept. 25, 1908. Physikal. Inst., Tübingen, July 2, 1908.)—The paper is mainly devoted to the discussion of what the author terms the longitudinal reversible permeability of iron—that is, the value of dB/dH when dH is a small retrograde change in the resultant magnetising force opposite in sign to the immediately preceding change in that quantity. Experimentally obtained curves are given connecting the value of the reversible permeability for the various points of a hysteresis cycle, with the magnetising force, and the intensity of magnetisation. The theory of the permanent magnet is then discussed with reference to reversible permeability, and it is shown (1) that this is roughly constant for all degrees of permanent magnetisation ; (2) that the stability of permanent magnets is enhanced if the magnetising current is reduced to a small negative value before being switched off. The reversible permeability of a split-ring permanent magnet is theoretically shown to be deducible from its dimensions, but the results of calculation do not compare well with those obtained experimentally. The paper concludes with a discussion of the Duhem-Cissotti theory of hysteresis, which appears not to be corroborated by the author's experiments. J. D. C.

1846. *Magnetic Permeability of Iron in Weak Fields of High Frequency* **F. Piola.** (Atti dell' Assoc. Elettr. Ital. 12. pp. 479–496, July–Aug., 1908.)—According to Rayleigh, the permeability of iron is constant from field 0·04 down to field 0·00004 [Phil. Mag. 23. p. 225, 1887]. The author describes measurements of the permeability for similar fields but made with alternating currents, the range of frequency including the frequencies necessitated by telephony. The method is to place the specimen in a solenoid which comprises one arm of a Wheatstone's bridge, the other three arms being exactly similar solenoids. The detector is a telephone receiver, a balance being produced before the introduction of the iron. On introducing the iron the arm is shunted by a condenser in series with resistance in order to restore the balance. The current in the bridge is also measured, and from this is found the field in which the iron is placed ; the permeability is determined from the increase in reactance of the coil in which it is placed. This coil lies at right angles to the other three and to the magnetic meridian. It is found that the permeability has the constant value 84·6 for fields up to 0·02 alternating or 0·028 maximum, and is independent of the frequency for values between 210 and 1,710 ∼ per sec. Hence the material is suitable for constructing telephone cables having distributed inductance. S. G. S.

1847. *Large Magnetic Storm, Sept. 11–12, 1908.* **C. Chree.** (Nature, 78. p. 508, Sept. 24, 1908.)—A large magnetic storm was felt at Kew on Sept. 11–12, 1908. While the movement of the horizontal force magnet was of a type which not unusually ushers in large storms, it was exceptionally large, representing an increase of about 112γ in horizontal force in less than two minutes of time. The declination traces are less pronounced, but show very decided features which are well shown in a reproduction of the magnetograph trace. The total range of declination was about 1° 27′. In vertical force the disturbance was of a somewhat unusual type. While there was a certain amount of oscillation, the principal feature was that during the whole duration of the storm the vertical component was depressed below its normal value. C. P. B.

1848. *Action of Electric Oscillations on the Magnetostriction of a Longitudinally Magnetised Wire.* **L. Tieri.** (Accad. Lincei, Atti, 17. pp. 204–208, Sept. 6, 1908.)—Using a form of extensometer giving readings by means of a mirror and spot, the author has been able to experimentally demonstrate that electric oscillations applied at various stages of a longitudinal magnetising cycle will either cause an increase or decrease in the length of the wire or no effect whatever, according to the stage. The behaviour is thus similar to that exhibited by the hysteresis and the magnetic moment, which have both previously been shown by others to behave in this way, though the author omits all reference to these facts. L. H. W.

ELECTRO-PHYSIOLOGY AND ELECTRO-THERAPEUTICS.

1849. *High-power Röntgen Tubes.* **J. Bergonié.** (Archives d'Él. Médicale, 16. pp. 779–788, Sept. 25, 1908.)—The author discusses generally the desiderata to be looked for in Röntgen-ray tubes, and arrives at the following conclusions. (1) It is advantageous to reduce the time of exposure as much as possible, and for this reason to employ tubes capable of working at high power. (2) The value of a tube can be defined by its "figure of merit," M, which the author gives as the product of the maximum current (in milliamps.) passing through the tube, by the maximum time (in seconds) during which it can support this current without deterioration while emitting No. 6 rays. (3) The dissipation of the heat set free at the antikathode has not yet found a satisfactory solution: water-cooling is unsatisfactory; the use of massive antikathodes is better, but even then the time of exposure must be limited. The metals Pt and Ir are bad conductors of heat, and hence should not be used, owing to their heating up unequally. L. H. W.

REFERENCES.

1850. *Principle of Relativity and Electromagnetic Mass of Electron.* **E. Cunningham.** (Phil. Mag. 16. pp. 423–428, Sept., 1908.)—This is a highly analytical paper written to defend the author's position in reply to an objection by A. H. Bucherer. [See Abstracts Nos. 2075 (1907) and 887 (1908).] E. H. B.

1851. *Registering of Atmospheric Potential.* **K. Kähler.** (Meteorolog. Zeitschr. 25. pp. 289–299, July, 1908.)—Describes the continuation of the researches previously dealt with [see Abstract No. 1160 (1908)]. In the present paper the effect of falls of snow, thunderstorms, wind without rain, and strong wind accompanied by dust is discussed. A. W.

1852. *Electron Emission from Glowing Oxides.* **F. Jentzsch.** (Ann. d. Physik, 27. 1. pp. 129–156, Sept. 25, 1908. Extract from Dissertation, Berlin.)—The full paper corresponding to Abstract No. 1489 (1908).

1853. *Ionisation of Air by Ultra-violet Light.* **F. Palmer, Jr.** (Nature, 77. p. 582, April 23, 1908.)—The ionising effect of light-rays of shorter wave-length than $\lambda = 1850$ has been measured, and it has been found that very considerable ionisation is produced, the amount increasing with decrease in wave-length.

E. C. C. B.

1854. *Apparatus for determining the Specific Inductive Capacity of Organic Liquids.* **A. W. Stewart.** (Chem. Soc., Journ. 93. pp. 1062–1064, June, 1908.)—The author describes a modification of Drude's apparatus (Zeits. Phys. Chem. 23. p. 267, 1897) with a view to (*a*) reducing the quantity of experimental liquid, (*b*) regulating the temperature of the apparatus, (*c*) avoiding the slight sparking and consequent uneven lighting of the vacuum tube, due to imperfect contact between the movable bridge and the wires of the secondary circuit. D. H. J.

1855. *Superposition Theorem for Alternating Currents experimentally established.* **H. Hausrath.** (Phys. Zeitschr. 9. pp. 678–681, Oct. 15, 1908.)—Describes experiments with a 14-kw. high-frequency machine which confirm the principle of superposition for alternating currents. E. H. B.

1856. *Explanation of Electrical and Optical Wave-phenomena.* **J. Sahulka.** (Jahrbuch d. Drahtlosen Telegraphie, 1. 3. pp. 411–420, May, and 1. 4. pp. 522–533, Sept., 1908.)—A non-mathematical *exposé* of the processes involved.

1857. *Direct Currents in Electrolytes without Electrodes.* **C. Hering.** (Amer. Electrochem. Soc., Trans. 13. pp. 273–284; Discussion, pp. 284–287, 1908.)—The author suggests a number of methods for generating direct currents in electrolytes without the use of electrodes. No results are given, since no experiments have been made. T. S. P.

1858. *Energy in Permanent Electromagnetic Field.* **K. Uller.** (Phys. Zeitschr. 9. pp. 529–537, Aug. 15, 1908.)—The author discusses, by means of elaborate mathematics, the flow of energy in a permanent electromagnetic field, use being made of Poynting's theorem. In a subsequent paper special cases will be discussed, general conclusions only being drawn here. A. W.

1859. *Magnetic Observations during Total Solar Eclipse.* **O. H. Tittmann.** (Terrestrial Magnetism, 12. pp. 153–160, Dec., 1907.)—By special arrangement with the Carnegie Institution the Coast and Geodetic Survey carried out a series of magnetic observations at the five magnetic observatories of the Bureau during the total solar eclipse of Aug. 30, 1905. Eye readings of declination were taken every minute, and the temperature read every 15 min. At Cheltenham the Eschenhagen magnetograph was also run on the "two-hour" rate. Observations were also made by the recorders of three field stations. All the results obtained are given in tables. C. P. B.

1860. *Orientation of an Anisotropic Ellipsoid in a Uniform Field.* **G. Meslin.** (Comptes Rendus, 146. pp. 1305–1308, June 22, 1908. Journ. de Physique, 7. pp. 861–872, Nov., 1908.)

1861. *Bar Magnets.* **H. Ruoss.** (Ann. d. Physik, 27. 1. pp. 113–128, Sept. 25, 1908. Physikal. Inst. d. tierärztl. Hochschule, Stuttgart, July, 1908.)—This paper consists of four sections. In the first of these the author seeks, without assuming any knowledge of the law of distribution of the free magnetism, for the magnet which is mathematically equivalent in its effect to a given bar magnet. Next, assuming the law of distribution $y = \pm cx^2$, the magnetic centre and equivalent pole are estimated. In the third section the question of an approximately equivalent magnet is dealt with, and in the last section is given a new method of determining the pole of a magnet. A. W.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

1862. *Search for Possible New Members of the Inactive Series of Gases.* **W. Ramsay.** (Roy. Soc., Proc. Ser. A. 81. pp. 178–180, Aug. 27, 1908.)—The periodic table shows gaps for two or three gases of the inactive series of higher atomic weight than xenon. An exhaustive search has failed to discover any new gas in the atmosphere, which the author says may be due to their being unstable like the emanations of radium, thorium and actinium. It is possible that the atomic weights of the last three are 172, 216, and 260, which fit in with gaps in the periodic table. [See Abstract No. 1759 (1908).]

E. C. C. B.

1863. *Do the Radio-active Gases (Emanations) belong to the Argon Series?* **W. Ramsay.** (Elect. Engineering, 4. p. 892; Discussion, p. 892, Sept. 10, 1908. Abstract of paper read before the British Assoc. at Dublin.)—The known elements of the argon series, with their atomic weights, are: Helium, 4; neon, 20; argon, 40; krypton, 88; xenon, 130. The further atomic weights to be expected from a consideration of the periodic system are 172, 218, and 262. Provisionally the author assigns the first of these to thorium emanation and the third to actinium emanation. T. H. P.

1864. *Electro-chemistry of Light.* III. **W. D. Bancroft.** (Journ. Phys. Chem. 12. pp. 417–447, June, 1908.)—The results of experiments on the action of halogens on aromatic hydrocarbons lead to the following conclusions. The action of halogen carriers is not due to the intermediate formation of additive compounds. Under suitable experimental conditions the halogen carriers react with benzene or toluene even when no free halogen is present. According to the author's theory, there is a slight reversible dissociation of bromine into positive and negative particles or gaseous ions, $Br_2 \rightleftarrows Br^+ + Br^-$ and also a slight reversible reaction between bromine and the positive gaseous ion, $Br_2 . Br^+ \rightleftarrows Br_2 + Br^+$. Substitution takes place in the ring when the negative gaseous ions are present in excess; otherwise it takes place in the side chain. The additive products of benzene are to be considered as analogous to the chain substitution products of toluene. There is a reversible dissociation of the halogen carriers with formation of so-called gaseous halogen ions, which may be positive or negative according to the nature of the carrier. By means of this theory the author accounts for the catalytic action of ferric, aluminium, and stannic chlorides, iodine monochloride, phosphorus pentachloride, water and sunlight, and for the reaction velocity relations with ferric, stannic, and aluminium chlorides, iodine monochloride and water. Experimental evidence is adduced in favour of the existence of aluminous compounds. [See also Abstract No. 1258 (1908).]

T. H. P.

1865. *Anomalous Rotatory Dispersion of Turpentine Oil, and its Relation to Composition.* **E. Darmois.** (Comptes Rendus, 147. pp. 195–197, July 20, 1908.)—By blending dextro- and lævo-rotatory turpentine oils, mixtures have been obtained having an anomalous rotatory dispersion, the rotation becoming zero for one colour of the spectrum, and passing through a minimum value for another colour. Fractionation of some dextro-oils has given fractions which also possess an anomalous dispersion, and it is concluded that these oils contain two optically active constituents of opposite sign, the dextro constituent having the greater dispersion and an optical rotation of about + 109°, *i.e.*, equal and opposite to that of *l*-pinene. W. H. Si.

1866. *Fixation of Nitrogen by Calcium Carbide.* **G. Pollacci.** (Zeitschr. Elektrochem. 14. pp. 565–566, Sept. 4, 1908. From Roy. Univ., Pavia, July, 1908.)—The author recommends the addition of potassium carbonate to the carbide in order to improve the fixation of nitrogen. As an addition of 4 per cent. is most effective (much more so than 20 per cent.), he considers the effect of the carbonate to be catalytic; $CaCl_2$ has to be applied in much higher percentages (10 and 20) to produce the same effect, and acts probably because it lowers the melting-point of the mixture. The author does not comment upon the fact that his carbide contained only 85 CaC_2 with 10 $Ca(OH)_2$ and 5 residue. He uses the furnace of Federico, an iron tube, closed at both ends by screwed tubular stoppers, lined inside and enclosing a tube of porcelain, embedded in kryptol. When the pressure of the nitrogen is raised to 2 atmos. the fixation is considerably hastened; an increase in the pressure to 4 atmos. does not further improve the yield. H. B.

1867. *Corrosion of Iron.* **C. F. Burgess.** (Amer. Electrochem. Soc., Trans. 13. pp. 17–48; Discussion, pp. 49–54, 1908.)—Experiments made by the author and J. Thickens show that the most severely strained parts of tensile and torsion test-pieces of mild steel are much more rapidly corroded, with or without the aid of a weak current in dilute HCl, than the unstrained parts. This difference is removed by annealing at 900° C. Another series of experiments, performed by the author and S. G. Engle, indicate that iron from which heat is flowing into the solution in which it is placed is usually electropositive to iron at the general temperature of the solution. Of these tests the principal were made with an apparatus in the form of a small boiler, with one fire-tube insulated from the shell by means of asbestos packing. The presence of oxygen in boiler water has much greater effect than CO_2 in promoting corrosion. During heating from the cold and for some time at a constant temperature, the p.d. reaches a max. value and then decreases. The decrease is in part due to the gradual elimination of oxygen, and in part to the formation of a deposit on the tube. The tube corroded locally in a similar manner to boiler tubes. F. R.

1868. *Rusting of Iron.* **W. A. Tilden.** (Chem. Soc., Journ. 93. pp. 1356–1364, July, 1908.)—The following conclusions are supported by experimental evidence: Commercial iron, liquid water, and oxygen are together sufficient for the production of rust. Carbon dioxide is not necessary, but when present hastens the action. Commercial iron is attacked by pure water in the absence of oxygen and CO_2, the product being, not rust, but ferrous hydroxide. Iron rust always contains ferrous oxide. The process of rusting is due initially to electrolytic action resulting in the production of ferrous hydroxide or carbonate. This may be explained by the presence in all ordinary iron of various components which afford surfaces at different potentials in the presence of water, aqueous carbonic acid, or other electrolyte. F. R.

1869. *Rusting of Iron.* **J. N. Friend.** (Iron and Steel Inst., Journ. 77. pp. 5–32, 1908. Mech. Eng. 22. p. 220, Aug. 21, 1908. Abstract.)—The author concludes that the electrolytic theory of the corrosion of iron is untenable, and that in general rusting occurs primarily by a process of acid attack due to the presence of traces of CO$_2$ together with moisture and oxygen. Cast iron only is attacked by pure cold or boiling water. The purer forms of iron are not affected by pure water and air, or steam and air, at 100° C. Pure H$_2$O$_2$ is without effect upon pure iron, but the commercial forms of iron are more or less affected according to the proportion of impurities which they contain. The corrosive action of rust is dependent on its hygroscopic nature, moisture and CO$_2$ being thus absorbed from the air and continuing the corrosion. Experiments failed to show conclusively whether pure iron can decompose pure steam at red heat or not. F. R.

1870. *Electric Furnace for Melting Iron.* **B. Igewsky.** (Iron and Steel Inst., Journ. 76. pp. 155–166, 1908. Elect. Engineering, 8. pp. 777–778, May 21, 1908. Engineering, 85. pp. 699–700, May 22, 1908. Abstracts in Elect. Rev., N.Y. 52. pp. 910–911, June 6, 1908. Electrician, 61. pp. 788–790, Sept. 4, 1908.)—The author built up furnaces of conductors of the second class (bricks of magnesia, limestone, &c., conducting only when hot). He found, however, that the current would soon practically be confined to accidental lines of least resistance. Together with Tzaref he has constructed in Kieff a revolving cylindrical furnace, turned by an electric motor, and built up of radial bricks, separated by electrodes of iron, which are bent over on the outer surface, on which stationary contact shoes rest. The inner hollow space has a diam. of 175 mm. and a capacity of 5 litres, but cannot take more than 2 litres at a time. To start the furnace it has to be heated inside with a Bunsen burner; some alkali is put in to provide a conducting layer, and the hot furnace charged with some molten iron to which solid iron is then added, not too much at the time, lest the charge solidify and short-circuit the current. The electrodes were originally plates 8 or 4 mm. in thickness, but thin sheet-iron will do, although it melts at the inner end. The 24 electrodes are separated by 28 mm. of brick; the p.d. between two adjoining electrodes is 85 volts; there has been trouble with sparking and with arcs, to overcome which the collector has been subdivided. Direct current at 250 volts is generally used; the author claims the utilisation of high-tension currents as one of the advantages of his furnace. The title speaks of smelting; the paper mentions only melting operations. H. B.

1871. *Influence of Rate of Cooling on the Composition of Saturated Solid Solutions.* **W. v. Lepkowski.** (Zeitschr. Anorg. Chem. 59. 8. pp. 285–292, Aug. 28, 1908. Metallographic Communication from the Inst. f. physikal. Chem. d. Univ., Göttingen.)—The author has examined the alloys of Sn with Bi, and Cu with Ag thermally, and microscopically, with a view to determining the possibility of obtaining supersaturated solid solutions, and to showing the effect of the rate of cooling on these alloys. *Sn-Bi alloys.*—Thermal analysis shows that the limit of solubility of Bi in Sn is about 6 per cent., but the microstructures of the Sn-rich alloys are so indefinite as to preclude the possibility of determining the composition of the saturated solid solutions by their aid. The Bi-rich alloys, cooled in the furnace, show distinctly the presence of eutectic in alloys containing 0·5 per cent. Sn. By casting the alloys in an ice-cooled mould it is possible to destroy the eutectic structure and obtain supersaturated solutions containing up to 1·5 per cent. Sn. These supersaturated solutions are stable up to 120° C., heating for 6 hours at that temperature producing no change in the structure. *Cu-Ag alloys.*—The cooling-curves and microstructures of the alloys cooled in the furnace, show the presence of eutectic in all alloys containing between 1 and 99 per cent. Cu. By heating for times up to 80 hours at 750° C., the structure of the Cu-rich alloys containing up to 6 per cent. Ag, and the Ag-rich alloys containing up to 5 per cent. Cu become homogeneous, and these figures are taken as representing the compositions of the saturated solid solutions. Supersaturated solid solutions cannot be obtained in this series. F. C. A. H. L.

1872. *Planimetric Analysis of Alloys. Structure of Phosphor-Copper.* **A. K. Huntington** and **C. H. Desch.** (Faraday Soc., Trans. 4. pp. 51–58; Discussion, pp. 58–59, July, 1908.)—The structure of a micro-section, which has been prepared in the usual way, is projected upon a screen, and the outlines of the constituents are traced in by hand. The planimeter is then used in the ordinary way to estimate the areas occupied by each constituent. In the case of a very small structure the areas are divided up into squares, and the relative proportions estimated by eye for each square and averaged. Thus in the case of a phosphor-copper containing by analysis 9·89 per cent. P, the planimeter gave 10·08, and the squares method 9·9 per cent. P. Other examples given include Cu-Al and Cu-Zn-Sn alloys. In studying the phosphorus-copper series by this method it was observed that the relation between the areas occupied by Cu, and percentage of P was not a straight line. The explanation offered for this is that some segregation of copper and of copper-phosphide from the eutectic occur. A correction is consequently applied, with an improvement in agreement. In the high-phosphorus samples the curve again lies above a straight line, and this it is suggested is due to imperfection of equilibrium. F. R.

1873. *Nitrogen in Iron.* **A. Grabe.** (Rev. de Métallurgie, 5. pp. 353–354, June, 1908. Metallurgie, 5. pp. 570–571, Oct. 8, 1908. Abstract.)—The author and J. Petren have critically examined the method of H. Braune for the determination of nitrogen in steel [Abstract No. 2119 (1905)], and find the probability of a large error due to the presence of nitride in the potash used, giving too high values of the nitrogen (Jernkontorets Annaler, pp. 1–30, 1907). A number of determinations give the following results: 12 Swedish soft irons, N 0·0020–0·0045 per cent.; 88 various steels, N 0·0025–0·0125 per cent.; 20 cast irons N 0·0010–0·0065 per cent. It appears unlikely that less than 0·015 per cent. N will have a serious effect upon the properties of steel, hence the presence of N in the amounts met with in commercial steels need not be considered cause for alarm. F. R.

1874. *Iron and Phosphorus.* **B. Saklatwalla.** (Iron and Steel Inst., Journ. 77. pp. 92–108, 1908.)—Thermal, microscopic, and hardness investigations. Up to 1·7 per cent., phosphorus forms a solid solution with iron, which forms a eutectic with Fe_3P, containing about 10·2 per cent. P, solidifying slightly above 1,000° C. At 16·2 per cent. P the eutectic of Fe_3P and Fe_2P is formed, which solidifies at 960°. Fe_2P forms a eutectic, probably with the next higher phosphide, solidifying at about 1,218°. A small amount of P increases the hardness of pure iron from 3·5 to between 5 and 5·5 on Mohs's scale. The eutectics are successively slightly harder. F. R.

1875. *Iron, Carbon, and Sulphur.* **D. M. Levy.** (Iron and Steel Inst., Journ. 77. pp. 33–91, 1908.)—The author finds that the iron-carbon alloys are essentially an iron-iron carbide system and that graphite only separates from carbide which has already separated, the carbide being stable whilst in solution. In cast irons free from Mn and Si, S up to 0·8 per cent. exists as FeS. FeS concentrates in the mother-liquor during cooling, and a triple eutectic, austenite-cementite-sulphide, forms at 1,130° C., the temperature falling slightly as S increases up to 0·8 per cent. On continued heating the tendency of the constituents to become massive is diminished if much sulphur be present, as the sulphide tends to persist in the form of films. Hence the iron remains white, and this explains why high sulphur-content hinders the malleablising of cast iron. F. R.

1876. *The Iron-Carbon Diagram.* **H. M. Howe.** (Amer. Inst. Mining Engin., Bull. 22. pp. 461-529, July, 1908.)—The evidence for and against the greater stability of graphite as compared with cementite, upon which the present double diagram rests, is discussed in detail. The change from cementite to graphite is exothermic, and hence in the direction of increased stability. This change does take place in spite of the opposing pressure arising from the bulkiness of the graphite. The habitual order of changes in general is first the production of the metastable, finally of the stable conformation, and whether the carbon is present in the molten iron, or is introduced as in cementation, the order of changes is the production of cementite, followed by the formation of graphite partly or wholly from the decomposition of the cementite. There is no evidence, either experimental or occurring in the production of malleable castings, to show that the reverse change, from graphite directly to cementite, ever occurs. In fact the amount of graphite produced frequently exceeds the 2·2 per cent. required to saturate austenite. An examination of the data of Charpy, Grenet, and Mannesmann leads to the rejection of solubility-lines based on the measurements of those workers, as in their work no differentiation was made between cementite and dissolved cementite or dissolved carbon. There is evidence that graphite is readily soluble in iron, but this is incomplete. As a result of elaborate argument the following table contains numbers deduced from published data, representing the provisional upper limits of the percentage solubility of carbon in austenite in presence of graphite.

Silicon, per cent.	500° to 600° C.	700°.	800°.	1,000°.
0·10 ±	—	—	—	0·92
2·10	—	0·28	0·54	—
3·15	0	0· (?)	—	—
4·23	—	—	0·19	—

These are only rough approximations, and are dependent on some admittedly questionable assumptions. The terms "pro-eutectoid ferrite" and "pro-eutectoid cementite" are introduced respectively in place of "excess ferrite" and "excess cementite," and "primaustenoid" signifies the network and masses, rich in ferrite and poor in carbon, which in hypo-eutectoid steel persist as undiffused relics of the primary austenite. F. R.

1877. *Cooling Power of Liquids, Rate of Quenching. Troostite and Austenite.* **C. Benedicks.** (Iron and Steel Inst., Journ. 77. pp. 153–257, 1908.)—The chief factor in deciding the cooling power of a liquid is its latent heat of vaporisation; the influence of specific heat is only of secondary importance, and thermal conductivity and probably internal friction are of negligible effect. Methyl alcohol is a more, and mercury a less powerful quenching liquid than water. The duration of cooling in quenching is directly proportional to the mass of cylindrical steel specimens, but almost independent of the area of their surface. The rate of cooling is decreased with increase of quenching temperature, and with increase of carbon and, possibly, silicon contents. The occurrence of troostite depends on rate of cooling, and not on quenching temperature. Its formation is accompanied by recalescence, and its resistivity and specific volume are the same as those of pearlite. These results are held to confirm the author's theory [see Abstract No. 411 (1906)] that troostite is a solid colloidal solution of cementite in iron. A study of the coagulation of colloids further confirms this view. Experimental evidence shows that the necessary condition for preserving austenite untransformed is the existence of a considerable pressure. During warming up from liquid-air temperature to atmospheric temperature a martensite-austenite sample which has been cooled in liquid air emits an audible sound during the transformation of austenite. The martensite of a martensite-austenite specimen is darkened by a 5 per cent. alcoholic solution of metanitrobenzolsulphonic acid. Austenite is more liable to rusting than martensite. F. R.

1878. *Electrical Testing of Iron during Annealing.* **E. E. F. Creighton.** (Amer. Electrochem. Soc., Trans. 13. pp. 127–131; Discussion, pp. 131–132, 1908.)—The heap of sheet-iron rings to be tested is made the secondary of a transformer whose iron circuit contains a gap. The heat generated by the current induced in the rings raises their temperature as desired, and they are surrounded by a lagging of asbestos. The electrical losses in the rings are observed by means of an asbestos-insulated copper winding in circuit with a wattmeter, ammeter, and voltmeter. The samples and transformer were enclosed in an outer iron case, and it was thus possible to study the action of various atmospheres upon the iron. Upon heating the metal as received from the rolling-mill, the core loss gradually fell from 2·9 watts per lb. with the conditions used, to 0·4 watt per lb. at 750° C. Upon cooling to atmospheric temperature the loss was 1·0 watt per lb. After heating to 800° in an atmosphere of ammonia the core loss in the same sample at atmospheric temperature was 8·85 watts per lb., the increase being due, it is suggested, to the absorption of nitrogen by the iron. The iron was ruined so far as electrical purposes were concerned. In the *discussion*, the **Author** states that heating in an atmosphere of nitrogen had no detrimental effect upon iron, and heating in hydrogen has in general a beneficial effect. F. R.

1879. *Effect of Phosphorus in Steel.* **J. de Kryloff.** (Rev. de Métallurgie, 5. pp. 355–360, June, 1908. Metallurgie, 5. pp. 569–570, Oct. 8, 1908. Abstract.) —A number of tensile tests and the results of microscopic examination of medium carbon steels lead to the following conclusions: Annealing at 750°–780° C. only removed brittleness which was due to overheating and indicated by a coarse general structure. Forging at 900° resulted in a great improvement of properties, particularly contraction of area. Oil quenching, followed by annealing at 750°, gave a marked increase in strength and ductility. It is not found possible, when phosphorus exceeds 0·07 per cent., to remove "ghosts" (carbonless bands) by thermal treatment, and they are in any case more difficult to eradicate by heat treatment the higher the phosphorus content of the steel. F. R.

1880. *Reduction of Refractory Oxides by Carbon.* **H. C. Greenwood.** (Chem. Soc., Journ. 93. pp. 1483–1496, Aug., 1908.)—The temperatures at which carbon begins to reduce the more difficultly reducible metallic oxides are determined. The apparatus consists of a graphite tube, containing the mixture of the oxide and carbon, mounted inside an evacuated glass globe in graphite plugs soldered into water-cooled brass tubes. The latter serve as leads for the heating current and are luted into the side arms of the vessel. The temperature is raised fairly rapidly to a dull red heat, and then raised by small steps, careful measurements being taken at each, until any desired value is attained. Temperature measurements are made by a Wanner optical pyrometer. The apparatus is suitable for use up to 2,000°, and is capable of maintaining the temperature constant to within about 10°. The reduction temperature is fixed by the marked increase in the gas evolution, shown by increase of pressure. The temperatures of reduction of the oxides examined are far below those which are generally supposed to be necessary, viz.: Chromium, 1,185°; Mn, 1,105°; U, 1,490°; Si, 1,460°; Zr, 1,400°; Th, 1,600° C. These reductions commence very sharply at a given temperature, but the progress of the reduction depends greatly on the intimacy of the contact, and thus on the degree of subdivision of the oxide and carbon. The reduction temperature is found to alter on using different varieties of carbon. In some cases differences are also indicated between samples of the oxides prepared under varying conditions, but the effect can be shown to be due to the physical state of the oxide. In all the cases studied the reaction takes place long before the melting-point of the oxide is reached, and the product of reduction is also in the unfused state. Experiments to measure the temperature dissociation of these oxides indicate that they are extremely stable (even in a high vacuum) up to temperatures far exceeding the reduction-point by carbon. C. O. B.

1881. *Production of Ferro-alloys.* **H. C. Greenwood.** (Chem. Soc., Journ. 93. pp. 1496–1500, Aug., 1908.)—The fact that it is much more difficult to produce elements such as Cr and Si by direct smelting of the oxides than to produce ferro-alloys from a mixture of the oxides with ferric oxide has been accounted for by the following suggestions: (1) Greater fusibility of the alloy, and consequent agglomeration of the reduction product into a mass escaping reoxidation or back reaction. (2) That the local increment of temperature due to the oxidation of carbon by the Fe_2O_3 might raise the temperature of the neighbouring particles of the more refractory oxide to that required for reduction. (3) Some definite chemical affinity between the two metals. Experiments are described for the determination of the reduction temperature of various oxides in the presence of iron, &c., similar to those described in the preceding Abstract. From these it is found that SiO_2, in the presence of finely divided iron, begins to be reduced by carbon at 1,050°, this being 410° lower than the reduction temperature by carbon alone. Fe_2O_3 does not exert any appreciable influence on the reduction of SiO_2 before itself undergoing reduction. Metallic Mn has a similar effect, SiO_2 being reduced at 1,100°, as against 1,460° without Mn. In the presence of metallic Cu reduction commences at 1,250°. From these experiments it would appear that the local raising of temperature by reduction of Fe_2O_3 does not play an important part, but that direct affinity between Si and the metals accounts for a good deal of the action. Iron in the metallic state or as Fe_2O_3 does not facilitate the reduction of Cr_2O_3 by carbon, but metallic Mn lowers the reduction temperature slightly. Iron also facilitates the reduction of MnO by carbon to a certain extent. C. O. B.

1882. *Researches upon Osmosis and Osmotic Pressure.* **L. Vegard.** (Phil. Mag. 16. pp. 247–271, Aug., and pp. 398–419, Sept., 1908.)—The author has carried out a number of direct measurements of the osmotic pressure of cane-sugar solutions, the principle of the method employed being the same as that used by Berkeley and Hartley, but the apparatus itself is simpler. The work involved also the preparation of copper ferrocyanide membranes, and the author discusses this point fully. The results of the author's measurements are as follows :—

Concentration, gm./litre.	Temp.	Osmotic Pressure.
40·0	0·0	2·88
159·9	0·0	12·15
268·9	9·25	23·17
319·9	0·0	28·80
320·0	0·0	28·85
337·5	4·4	31·57
396·2	7·0	39·85
520·0	11·5	63·80

The numbers are in good agreement with those obtained by Berkeley and Hartley and by Morse and Frazer. The above pressures, which are really reversion pressures at which the osmotic flow changes direction, are dependent on the qualities of the membrane as well as on concentration of solution, The author has determined this temperature effect, and finds between 0° and 11·5°, $\left(\frac{d\pi}{dt}\right)_c > 0{\cdot}00296$, for $C = 161$; and $\left(\frac{d\pi}{dt}\right)_c > 0{\cdot}0017$, for $C = 320$. This temperature effect is made up of (1) the temperature effect upon the permeability of the membrane, (2) the temperature effect upon osmotic pressure, and these two effects counteract each other. Special experiments must be made to determine the second factor. A. F.

1883. *Density and Latent Heat of Ice: Molecular Depression of Freezing-point in Aqueous Solutions.* **W. A. Roth.** (Zeitschr. Phys. Chem. 63. 4. pp. 441–446, July 21, 1908.)—The molecular depression of freezing-point in aqueous solutions is not known very accurately, owing to the uncertainty of the latent heat of ice. Consideration of previous work on this subject leads the author to conclude that the most probable value for this magnitude is 1·858°, whilst those for the density (D_0°) and latent heat of ice are 0·9168 79·67 cals. respectively. T. H. P.

1884. *Influence of the Silent Discharge on Explosive Gas Mixtures.* **H. Fassbender.** (Zeitschr. Phys. Chem. 62. 6. pp. 743–759, June 2, 1908.)—The influence of a silent discharge on a mixture of CO and oxygen increases its rapidity of explosion, probably owing to partial conversion of the oxygen into ozone. It is, indeed, found that a mixture of CO and O_3 exhibits a higher explosion velocity than one of CO and O_2. The explosion of a mixture of CO and O_2 itself results in the formation of a certain amount of ozone. In the case of a dry mixture of hydrogen and chlorine, in which the formation of ozone is excluded, the violence of the explosion is not affected by the influence of the silent discharge. The silent discharge does not, however, bring an explosive gas mixture into a permanent, more highly dissociated condition, the dissociation products immediately combining to form neutral molecules. The formation of dissociation products and their recombination under the influence of the silent discharge may proceed so energetically as to lead to ignition and explosion. This result may be general for all ionisers, for example, radium. T. H. P.

1885. *New Determinations of the Alteration in Free Energy by the Formation of some Molten Salts of the Heavy Metals.* **R. Lorenz** and **M. G. Fox.** (Zeitschr. Phys. Chem. 63. 1. pp. 109–120, June 9, 1908.)—Experiments with lead chloride show, in agreement with earlier observations, that the e.m.f. of a Cl-electrode (against Pb) approaches a constant max. polarisation value of about 1·2 volts at 600° C., when the apparatus is so constructed that the electrode is completely immersed in an atmosphere of Cl, and no lead fog, which would act as a depolariser, can come in contact with it. The Cl- (or Br-) electrode used consisted of a hollow carbon tube kept charged with the halogen, and it was shown that it was reversible, and that the max. value of the polarisation was not due to supersaturation phenomena. The values of the e.m.f. for the combination $Pb/PbCl_2/Cl$ were measured over a temperature-interval of 498°–600° C., and are given by the formula $e_{PbCl_2} = 1{\cdot}268 - 0{\cdot}000679\,(t - 498°)$. The results obtained with other salts are—

$$\begin{array}{llll} e_{CdCl_2} = 1{\cdot}258 & - 0{\cdot}000750\,(t - 560°) & \text{between } 560° & \text{and } 740° \\ e_{PbBr_2} = 1{\cdot}0945 & - 0{\cdot}000714\,(t - 367°) & \quad ,, \quad 367° & \quad ,, \quad 640° \\ e_{CdBr_2} = 1{\cdot}045 & - 0{\cdot}000742\,(t - 580°) & \quad ,, \quad 580° & \quad ,, \quad 720°. \end{array}$$

For a eutectic mixture of lead chloride and potassium chloride (1 : 1)—

$$e_{PbCl_2\,.\,KCl} = 1{\cdot}362 - 0{\cdot}000658\,(t - 407°) \text{ between } 407° \text{ and } 685°.$$

The melting-points of the salts used were also determined to within ½ per cent. accuracy. They were—

$PbCl_2$, 498° ; $PbCl_2 + KCl$, 407° ; $PbBr_2$, 367° ; $CdCl_2$, 560° ; $CdBr_2$, 580°.

T. S. P.

1886. *Copper Anodes in Chloride Solutions.* **S. Dushman.** (Amer. Electrochem. Soc., Trans. 13. pp. 313–318, 1908.)—In concentrated HCl copper anodes dissolve with valency 1 ; in diluted solutions the valency increases up to 2, the rate of charge depending upon circulation, current-density, &c. Confirming the conclusions of Abel, Luther, Bodländer, and Storebeck as to chemical equilibrium, the author investigates the concentration of the electrolyte at the anode in a cell of special construction, two concentric porous cylinders, partly closed, surrounding the anode within the cell. This anode is rotated 1,500 times per min. ; the electrolyte is HCl freed of air and then saturated with CO_2, a solution which hardly dissolves any copper when not under current. According to Nernst and Brunner, the diffusion in a rapidly stirred solution is limited to a very thin layer close to the anode ; he estimates the thickness of this layer at 6×10^{-4} cm. Assuming instantaneous equilibrium at the boundary between anode and solution, the apparently erratic results are reduced to agreement with Faraday's law. The research is not yet completed. H. B.

1887. *Reversed Electrolysis.* **J. W. Turrentine.** (Journ. Phys. Chem. 12. pp. 448–467, June, 1908.)—The primary changes during electrolysis are oxidation at the anode and reduction at the kathode, but the inverse process may occur owing to secondary change among the products of electrolysis.

Thus, when Fehling's solution is electrolysed, cuprous oxide is deposited on the anode, owing to the reducing action of the formic acid resulting from the oxidation of the tartaric acid. The author gives instances in which hydrogen is formed at the anode and oxygen at the kathode. Thus, when sodium sulphate solution is electrolysed with a Pt kathode and a Mg anode, a little oxygen and much hydrogen are evolved at the latter; a soluble salt of monovalent Mg is probably first formed, this then decomposing spontaneously into a salt of the divalent metal and hydrogen: $Mg_2SO_4 + 2H_2O = MgSO_4 + Mg(OH)_2 + H_2$. A similar action occurs with Al anodes, the existence of mono- or di-valent Al being thus indicated. When potassium permanganate is electrolysed in sulphuric acid solution, oxygen and hydrogen are evolved at the kathode, which also becomes coated with manganese dioxide. When the formation of a solid coating was prevented by means of a rotating kathode no gas was evolved but the permanganate was reduced quantitatively. In the kathodic evolution of oxygen the intermediate formation of H_2O_2 probably plays a part. T. H. P.

1888. *Electrolytic Determination of Thallium: Probable Existence of a New Thallium Oxide.* **G. Gallo** and **G. Cenni.** (Accad. Lincei, Atti, 17. pp. 276–284, Sept. 20, 1908.)—The electrolytic determination of thallium presents some difficulty, owing to the simultaneous deposition of metal on the kathode and oxide on the anode, but the author has obtained satisfactory results by electrolysing, at the ordinary temperature, a thallium solution, rendered faintly acid with oxalic acid, employing as kathode a rotating disc of Pt, making 800 revs. per min., and using a current of 0·15–0·20 amp. at a p.d. of 3–4 volts. The thallium is completely deposited as a brown oxide, which gradually becomes black, and appears to correspond to the formula Tl_3O_5, or an equimolecular mixture of Tl_2O_3 and TlO_2. W. H. Si.

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1889. *Preparation of Radium from Pitchblende.* **H. Paweck.** (Zeitschr. Elektrochem. 14. pp. 619–628, Sept. 11, 1908. Paper read before the Deutsch. Bunsen-Gesell., May 30, 1908.)—A detailed description of the large number of steps in the isolation of radium from pitchblende. T. H. P.

1890. *Selenium and Iodine.* **G. Pellini** and **S. Pedrina.** (Accad. Lincei, Atti, 17. pp. 78–81, July 19, 1908.)—From determinations of the melting and solidifying points of mixtures of selenium and iodine in different proportions, the authors conclude that the compounds described by Schneider were not true compounds, but mixtures. A eutectic is formed melting at 58° C., and corresponding almost exactly in composition to Se_2I_2. W. H. Si.

1891. *Osmotic Pressure of Cane-sugar Solutions at 10°.* **H. N. Morse** and **H. V. Morse.** (Amer. Chem. Journ. 39. pp. 667–680, June, 1908.)—In this series of observations the error due to water being sucked in by the solution during the opening and closing of the cell, which amounted in previous series to 2·8, 1·47, and 1·28 per cent., was eliminated completely in 12 out of 20 experiments. The discussion of the results is reserved for a later paper. T. M. L.

1892. *Metallurgical and Chemical Laboratories of the National Physical Laboratory.* **W. Rosenhain.** (Iron and Steel Inst., Journ. 76. pp. 87–106; Discussion and Correspondence, pp. 107–108, 1908. Communicated from the National Physical Laboratory.)